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Scientific and Technical Aerospace Reports

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01 AERONAUTICS (GENERAL)

N91-11666# Colorado Univ., Boulder. School of Journalism and Mass Communication.
AN ASSESSMENT OF MEDIA COVERAGE OF THE B-2 STEALTH BOMBER M.S. Thesis
Virginia L. Sullivan 1990 131 p Sponsored by AFIT, Wright-Patterson AFB, OH
(AD-A224646; AFIT/CI/CIA-90-034) Avail: NTIS HC/MF A07 CSCL 05/5

The B-2 Stealth bomber was labelled by some media as the most expensive airplane ever, while others have proclaimed it as the most innovative and most efficient aircraft ever built. This dichotomy of the press can be attributed to the sources being quoted in a specific article, according to the results of this study. The content analysis of hard news stories in the New York Times, the Washington Post, and the Los Angeles Times revealed that from the 13 categories analyzed as favorable or unfavorable, 55 percent of the 365 articles were favorable; the remainder was classified neutral because the direction equalled zero. The qualitative part of this study consisted of personal and telephone interviews with military and political leaders. Although some military leaders expressed contempt for the media, they mainly pointed fingers at Congress for being tenuous in statements about the B-2 to the press. Since certain aspects of the media coverage were unfavorable, the media appeared to rely more on the agenda set by Congress than the military leaders' agenda. However, since both Congress and the military placed the B-2 prominently on their agendas, so did the press. GRA

N91-11724# Deutsche Luftverkehrsgellschaft m.b.H., Frankfurt (Germany, F.R.).
MAINTAINABILITY OF REGIONAL AIRCRAFT
W. Hergesell *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 127-12 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N91-11667*# Texas Univ. at Dallas, Richardson. Center for Space Sciences.
THE STUDY OF PRESSURE MEASUREMENT TECHNIQUES AND DEVICES IN THE RANGE OF 10(EXP -1) TO 10(EXP -5) TORR (2 MILLIPSI TO 0.2 MICROPSI) Final Report, 1 Dec. 1989 - 9 Jun. 1990
John H. Hoffman 29 Aug. 1990 29 p
(Grant NAG1-989)
(NASA-CR-186926; NAS 1.26:186926) Avail: NTIS HC/MF A03 CSCL 01A

The atmospheric pressure range was studied in a region where conventional pressure sensing devices do not provide meaningful measurements. However, a hot filament gauge was developed and miniaturized which will measure the pressure in the 10(exp -1) to 10(exp -5) torr (2 millipsi to 0.2 micropsi) region, hence the name Micropsi gauge. Laboratory studies were made comparing the currently available devices with the newly developed miniature low power 'Micropsi' pressure sensor. Author

N91-11668 Georgia Inst. of Tech., Atlanta.
A NOVEL APPROACH FOR ANALYZING SUPERSONIC HIGH REYNOLDS NUMBER FLOWS WITH SEPARATION Ph.D. Thesis
Gregory Dan Power 1990 179 p
Avail: Univ. Microfilms Order No. DA9023826

A physically based computational technique to solve the steady Navier-Stokes equations for the above class of problems is developed. This is accomplished by tailoring the analysis to reflect the dominant mechanism of strong viscous/inviscid interaction as determined from experimental observations and mathematical theories. A reduced set of composite equations, derived from the full Navier-Stokes equations, is solved in a globally-iterated, space-marching manner where upstream influence is modelled through the introduction of the stream function along a single line oriented in the streamwise direction and located within the viscous region. This technique for solving the composite equations represents an extension of established two-layer interacting viscous-layer approaches. It should be applicable to a broader range of flow conditions than the two-layer methods while providing a comparable level of efficiency and thus could provide an effective alternative to time-marching algorithms. Computational results are presented for the cases of normal slot injection into a supersonic stream and shock/boundary-layer interaction with and without separation. These results compare favorably with results computed using an asymptotic analysis, results computed using a time-marching Navier-Stokes procedure, and available experimental data. In addition to verifying that the current technique accurately models complex supersonic flows with strong viscous/inviscid interaction, the results also confirm that for steady flows the effects of the inviscid elliptic characteristics associated with the small subsonic region near the surface are negligibly small compared to the effects of the displacement-thickness/pressure-gradient interaction mechanism. Dissert. Abstr.

N91-11669 Southampton Univ. (England).
DYNAMIC EFFECTS OF HYPERSONIC SEPARATED FLOW Ph.D. Thesis
Timothy Peter Roberts 1989 227 p
Avail: Univ. Microfilms Order No. BRD-89586

The results of an investigation into the static and dynamic behavior of the hypersonic separated flow generated over a flat plate-rearward flap configuration are reported with particular emphasis on the dynamic aspects. A range of flap deflection angles up to 35 degrees were considered. For the dynamic tests, the form of the motion of the flap was such that it was rapidly driven up from an almost zero degree angle of attack, to one of about 40 degrees, and then rapidly reversed. The investigation involved some theoretical modelling, and an experimental program in which extensive static pressure measurements and flow visualization studies were made. The experimental results showed that the rapid motion of the flap introduced some unsteadiness into the

flow over the model, particularly near reattachment. In addition it was observed that the growth or decay of the separation region 'lags' behind the changing flap angle, and that the extent of this lag is to first order, proportional to the flap angular velocity. Using this linear relationship, the experimental data were interpreted to obtain the difference in flap angles at which a given position of separation would be obtained, between that for the flap rising and that for the flap falling, both with a flap angular velocity of 51 rad/s. The experimental results have shown that the overall force and moment coefficients on the model, for the flap angular velocity range of -51 to +51 rad/s, differ by no more than -3.8 percent of the quasi-steady value. Dissert. Abstr.

N91-11670 Notre Dame Univ., IN.
COMPRESSIBLE FLOWS WITH PERIODIC VORTICAL DISTURBANCES AROUND LIFTING AIRFOILS Ph.D. Thesis
James Russell Scott 1990 232 p
Avail: Univ. Microfilms Order No. DA9023948

A numerical method is developed for solving periodic, three-dimensional, vortical flows around lifting airfoils in subsonic flow. This first-order method fully accounts for the distortion effects of the nonuniform mean flow on the convected upstream vortical disturbances. The unsteady velocity is split into a vortical component and an irrotational field whose potential satisfies a nonconstant-coefficient, inhomogeneous, and convective wave equation. Using an elliptic coordinate transformation, the unsteady boundary value problem is solved in the frequency domain on grids. In general, the agreement between the numerical and analytical results is very good for reduced frequencies ranging from 0 to 4, and for Mach numbers ranging from .1 to .8. Numerical results are also presented for a wide variety of flow configurations to determine the effects of airfoil thickness, angle of attack, camber, and Mach number on the unsteady lift and moment of airfoils subjected to periodic vortical gusts. Each of these parameters can have a significant effect on the unsteady airfoil response to the incident disturbances, and the effect depends strongly upon the reduced frequency and the dimensionality of the gust. For a one-dimensional or two-dimensional gust, the results indicate that airfoil thickness increases the unsteady lift and moment at the low reduced frequencies but decreases it at the high reduced frequencies. It is shown that mean airfoil loading leads to a significant reduction in the unsteady lift and moment for the low reduced frequencies, but a significant decrease for the high reduced frequencies. Dissert. Abstr.

N91-11671 Georgia Inst. of Tech., Atlanta.
UNSTEADY VORTEX LATTICE AERODYNAMICS FOR ROTOR AEROELASTICITY IN HOVER AND IN FORWARD FLIGHT Ph.D. Thesis
Kyung Min Yoo 1990 223 p
Avail: Univ. Microfilms Order No. DA9023837

An unsteady vortex lattice method was applied and was shown to be an improvement over the classical two-dimensional quasi-steady aerodynamics. A number of code validation studies were carried out including comparison of the present method with experimental data and other methods. To develop a computational model of the rotor and its wake, a thin lifting surface and wake were discretized into bound, shed, and trailing vortex filaments fixed in a prescribed wake geometry. Also, to consider the unsteady wake aeromechanism among the blades, each blade's motion and deformation were treated. The unsteady induced inflow was calculated and compared with experiment and other inflow models. The results for a two-bladed hovering rotor clearly show the effects of the three-dimensional tip-relief effect and the unsteady wake dynamics effect of the near and returning wake undergoing various unsteady motions. The present thin lifting surface theory was also applied to a coupled flap-lag-torsion stability analysis for the hovering flight condition. The perturbed time histories of coupled flap-lag-torsional motions were analyzed by Fourier analyses to predict the damping and frequencies of particular modes. The overprediction of lead-lag damping by the two-dimensional quasi-steady aerodynamics is shown to be due to a lack of both three-dimensional tip-relief effects and unsteady wake dynamics of the near and returning wake. In forward flight, the present method is applied to aeroelastic response predictions for both low and high advance ratios. In low speed flight, there exists a strong blade-wake interaction which is diminished in high speed flight. Dissert. Abstr.

N91-11672 Purdue Univ., West Lafayette, IN.
THREE-DIMENSIONAL FULL POTENTIAL METHOD FOR THE AEROELASTIC MODELING OF PROPFANS Ph.D. Thesis
Chieh-Chang Ku 1989 132 p
Avail: Univ. Microfilms Order No. DA9018856

Three dimensional, unsteady, subsonic, and transonic flow through a single rotation propeller is studied. The unsteady loads on the blades are obtained by solving the full potential equations using an implicit time marching scheme. The purpose of the code is to provide a capability of doing propfan aeroelastic analysis in the nonlinear transonic regime. Results are shown for steady state aerodynamic loading, unsteady aerodynamic response to forced aeroelastic deformations, and free aeroelastic response. The aerodynamic analysis is based on a finite volume discretization of the potential equations. The scheme is fully implicit, with the resulting nonlinear algebraic equations being solved in conservation form by an approximately factored quasi-Newton iteration at each time step. The blade dynamics are based on the in vacuum modes and frequencies. The scheme uses a moving grid that conforms instantaneously to the deforming blade shape. Grids are generated, a priori, for the undeformed blade and for unit deformations in each of the in vacuum modes. Dynamic grids are then set by linear superposition based on the current state vector of the blade. The aeroelastic analysis of propfans was addressed in two ways: frequency domain analysis and time domain simulation. The frequency domain solution uses the generalized forces that are obtained from transfer function analysis. The results are compared directly to a linear panel method in terms of damping coefficients. Dissert. Abstr.

N91-11673*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DEVELOPMENT OF UNSTRUCTURED GRID METHODS FOR STEADY AND UNSTEADY AERODYNAMIC ANALYSIS
John T. Batina Nov. 1990 13 p Presented at the 17th Congress of the International Council of the Aeronautical Sciences, Stockholm, Sweden, 10-13 Sep. 1990
(NASA-TM-102730; NAS 1.15:102730; ICAS-90-6.9.4) Avail: NTIS HC/MF A03 CSCL 01A

The current status of the development of unstructured grid methods in the Unsteady Aerodynamics Branch at NASA-Langley is described. These methods are being developed for steady and unsteady aerodynamic applications. The flow solvers that were developed for the solution of the unsteady Euler and Navier-Stokes equations are highlighted and selected results are given which demonstrate various features of the capability. The results demonstrate 2-D and 3-D applications for both steady and unsteady flows. Comparisons are also made with solutions obtained using a structured grid code and with experimental data to determine the accuracy of the unstructured grid methodology. These comparisons show good agreement which thus verifies the accuracy. Author

N91-11674*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THREE-DIMENSIONAL FLUX-SPLIT EULER SCHEMES INVOLVING UNSTRUCTURED DYNAMIC MESHES
John T. Batina Nov. 1990 9 p Presented at the 21st AIAA Fluid Dynamics, Plasma Dynamics and Lasers Conference, Seattle, WA, 18-20 Jun. 1990 Previously announced in IAA as A90-38777
(NASA-TM-102731; NAS 1.15:102731; AIAA-90-1649) Avail: NTIS HC/MF A02 CSCL 01A

Improved algorithms for the solution of the 3-D time dependent Euler equations are presented for aerodynamic analysis involving unstructured dynamic meshes. The improvements were developed recently to the spatial and temporal discretizations used by

unstructured grid flow solvers. The spatial discretization involves a flux split approach which is naturally dissipative and captures shock waves sharply with at most one grid point within the shock structure. The temporal discretization involves either an explicit time integration scheme using a multistage Runge-Kutta procedure or an implicit time integration scheme using a Gauss-Seidel relaxation procedure which is computationally efficient for either steady or unsteady flow problems. With the implicit Gauss-Seidel procedure, very large time steps may be used for rapid convergence to steady state, and the step size for unsteady cases may be selected for temporal accuracy rather than for numerical stability. Steady flow results are presented for both the NACA 0012 airfoil and the ONERA M6 wing to demonstrate applications of the new Euler solvers. A description of the Euler solvers is presented along with results and comparisons which assess the capability.
Author

N91-11675*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EFFECT OF ACOUSTIC EXCITATION ON STALLED FLOWS OVER AN AIRFOIL
K. B. M. Q. Zaman Oct. 1990 14 p Presented at the 13th Aeroacoustics Conference, Tallahassee, FL, 22-24 Oct. 1990; sponsored in part by AIAA
(NASA-TM-103183; E-5563; NAS 1.15:103183; AIAA-90-4010) Avail: NTIS HC/MF A03 CSCL 01A

The effect of acoustic excitation on post-stalled flows over an airfoil, i.e., flows that are fully separated from near the leading edge, is investigated. The excitation results in a tendency towards reattachment, which is accompanied by an increased lift and reduced drag, although the flow may still remain fully separated. It is found that with increasing excitation amplitude, the effect becomes more pronounced but shifts to a Strouhal number which is much lower than that expected from linear, inviscid instability of the separated shear layer. Author

N91-11676*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NUMERICAL STUDY OF UNSTEADY SHOCKWAVE REFLECTIONS USING AN UPWIND TVD SCHEME
Andrew T. Hsu (Sverdrup Technology, Inc., Brook Park, OH.) and Meng-Sing Liou Aug. 1990 16 p
(NASA-TM-103251; E-5680; NAS 1.15:103251) Avail: NTIS HC/MF A03 CSCL 01A

An unsteady TVD Navier-Stokes solver was developed and applied to the problem of shock reflection on a circular cylinder. The obtained numerical results were compared with the Schlieren photos from an experimental study. These results show that the present computer code has the ability of capturing moving shocks. Author

N91-11677# Army Combat Systems Test Activity (Provisional), Aberdeen Proving Ground, MD.
PROJECTILE VELOCITY AND TIME OF FLIGHT MEASUREMENTS Final Report
17 May 1990 39 p
(AD-A224921; ITOP-4-2-805) Avail: NTIS HC/MF A03 CSCL 19/10

This International Test Operating Procedure (ITOP) describes techniques and equipment employed to measure instrumental velocity of projectiles, the velocity along the trajectory, and the time of flight of the projectile to known ranges, including techniques for translating instrumental velocity of projectiles into muzzle or striking velocity. GRA

N91-11678# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
HYPERSONIC AERODYNAMICS AND CONTROL Final Report, 4 Apr. 1988 - 3 Jun. 1990
T. C. Adamson, Jr., R. M. Howe, E. G. Gilbert, N. X. Vinh, A. F. Messiter, and B. vanLeer 6 Jun. 1990 295 p
(Contract DASG60-88-C-0037)
(AD-A225058) Avail: NTIS HC/MF A13 CSCL 16/2

The use is discussed of gas injection from the surface of a hypervelocity vehicle such that the effective shape of the body is changed to obtain desired aerodynamic forces and thus desired vehicle control; this type of aerodynamic control represents a gas injection scheme which might possibly be used for control both inside and outside the atmosphere. Optimal trajectories and control were determined for trajectories and control multi-stage surface launched interceptors with ranges of several thousand miles and flight times of a few minutes; both propulsive and aerodynamic controls were considered, and trajectory optimization was based on minimizing the total interceptor mass ratio. In the aerodynamic control work, studies were made of gas injection into the boundary layer on one side of a thin wedge in steady hypersonic flow. To ascertain the magnitudes of the largest force changes available with blowing, gas injection rates large enough to cause the boundary layer to be blown off the body were considered. Conditions for the desired flight envelope are such that laminar flows could be considered. A fundamental conclusion reached is that relatively large aerodynamic force changes can be obtained with relatively small rates rates of gas injection. GRA

N91-11679# National Aeronautical Establishment, Ottawa (Ontario).
A SUMMARY OF TRANSONIC NATURAL LAMINAR FLOW AIRFOIL DEVELOPMENT AT NAE Aeronautical Note
M. Khalid and D. J. Jones May 1990 136 p
(AD-A225102; NAE-AN-65; NRC-31608) Avail: NTIS HC/MF A07 CSCL 01/1

This report contains an analysis of the experimental results obtained from four supercritical natural laminar flow airfoils investigated in the NAE High Reynolds Number Test Facility. The airfoils have maximum thickness to chord ratios of 0.10, 0.13, 0.16 and 0.21 and were designed for a lift coefficient 0.6. Their design Mach numbers were 0.8, 0.76, 0.72 and 0.68 respectively and the design chord Reynolds number was 12.5 million. It was found that all the airfoils showed the presence of a drag bucket close to design conditions and long lengths (in some cases about 70 percent) of natural laminar flow at Reynolds number 6.7 million. The minimum drag for the airfoils was found to range from 0.0045 to 0.0051, representing far lower levels than any airfoil dominated by turbulent boundary layer. It is also indicated that, with transition fixed at about 10 percent chord, the drag levels were similar to other airfoils with turbulent boundary layers. GRA

N91-11680# European Space Agency, Paris (France).
HALF-MODEL TESTS ON AN ONERA CALIBRATION MODEL IN THE TRANSONIC WIND TUNNEL, GOETTINGEN (FEDERAL REPUBLIC OF GERMANY)
Wolfgang Lorenz-Meyer (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen, Germany, F.R.) Aug. 1990 43 p Transl. into ENGLISH of Halbmodell-messungen an einem ONERA-Eichmodell im Transsonischen Windkanal Goettingen (Goettingen, Fed. Republic of Germany, DFLR), May 1989 44p Original language document was announced as N90-18370
(ESA-TT-1195; DLR-Mitt-89-20; ETN-90-98009) Avail: NTIS HC/MF A03; original German version available from DLR, Wissenschaftliches Berichtwesen, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 18.50 Deutche marks

Force and pressure distribution measurements were carried out at three wing sections on a calibration model in a 1m by 1m transonic wind tunnel. The model was mounted on the half model balance without a splitter plate but with a 5 mm thick boundary layer trap. The results are compared with complete model tests. The coefficients cannot be adequately corrected by the use of linear correction rules. Some oil film photographs were prepared for flow visualization purposes. ESA

N91-11681# Naval Postgraduate School, Monterey, CA.
MAPPING THE AIRWAKE OF A MODEL DD-963 ALONG SPECIFIC HELICOPTER FLIGHT PATHS M.S. Thesis
Gustav A. Anderson Dec. 1989 93 p
(AD-A225327) Avail: NTIS HC/MF A05 CSCL 01/1

A continuation was made of flow visualization studies done in the NPS low speed environmental wind tunnel. The long term goal is to map the airwake around a ship model and scale to full size for the purpose of determining safe operating envelopes on non-aviation ships. This project used hot wire and hot film anemometry to establish a data base for helicopter approach paths at 0 deg, 30 deg port, and 30 deg starboard ship yaw angles. Calibration of the wind tunnel revealed that some turbulence generators, used in two previous studies, created excessive turbulence intensity levels and were subsequently removed. Analysis along the flight paths was done with and without the model in place. The comparison showed that turbulence intensity levels of up to 50 percent were experienced in the proximity of the flight deck. These levels fell by 40 to 50 percent within 1/4 ship length along all approach paths. The starboard yaw approach path contained the greatest turbulence magnitudes and the 0 deg yaw contained the least. GRA

N91-11727# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Entwurfsaerodynamik.
LAMINAR FLOW WING
G. Redeker *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 137-14 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N91-11682*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AIRBORNE WIND SHEAR DETECTION AND WARNING SYSTEMS. SECOND COMBINED MANUFACTURERS' AND TECHNOLOGISTS' CONFERENCE, PART 1
Amos A. Spady, Jr., comp., Roland L. Bowles, comp., and Herbert Schlickenmaier, comp. (Federal Aviation Administration, Washington, DC.) Jul. 1990 347 p Conference held in Williamsburg, VA, 18-20 Oct. 1988
(NASA-CP-10050-Pt-1; NAS 1.55:10050-Pt-1) Avail: NTIS HC/MF A15 CSCL 01C

The Second Combined Manufacturers' and Technologists' Conference hosted jointly by NASA Langley (LaRC) and the Federal Aviation Administration (FAA) was held in Williamsburg, Virginia, on October 18 to 20, 1988. The purpose of the meeting was to transfer significant, ongoing results gained during the second year of the joint NASA/FAA Airborne Wind Shear Program to the technical industry and to pose problems of current concern to the combined group. It also provided a forum for manufacturers to review forward-look technology concepts and for technologists to gain an understanding of the problems encountered by the manufacturers during the development of airborne equipment and the FAA certification requirements. For individual titles, see N91-11683 through N91-11694.

N91-11683*# American Airlines, Inc., Fort Worth, TX.
TOOLS FOR THE TRADE
Wallace M. Gillman *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 1 Jul. 1990 p 11-21 (For primary document see N91-11682 03-03)
Avail: NTIS HC/MF A15 CSCL 01C

A brief review is given of daily operations in the airline business, with emphasis on the decisions made by pilots and the information used to make those decisions. Various wind shears are discussed as they affect daily operations. The discussion of tools focuses on airborne reactive and predictive systems. The escape maneuver used to fly out of a severe windshear is from a pilot's point of view. Author

N91-11684*# Honeywell, Inc., Phoenix, AZ. Sperry Commercial Flight Systems Group.
FLIGHT EXPERIENCE WITH WINDSHEAR DETECTION
Terry Zweifel *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 1 Jul. 1990 p 59-70 (For primary document see N91-11682 03-03)
Avail: NTIS HC/MF A15 CSCL 01C

Windshear alerts resulting from the Honeywell Windshear Detection and Guidance System are presented based on data from approximately 248,000 revenue flights at Piedmont Airlines. The data indicate that the detection system provides a significant benefit to the flight crew of the aircraft. In addition, nuisance and false alerts were found to occur at an acceptably low rate to maintain flight crew confidence in the system. Data from a digital flight recorder is also presented which shows the maximum and minimum windshear magnitudes recorded for a representative number of flights in February, 1987. The effect of the boundary layer of a steady state wind is also discussed. Author

N91-11685*# Honeywell, Inc., Phoenix, AZ. Sperry Commercial Flight Systems Group.
INTERFACE STANDARDS FOR INTEGRATED FORWARD-LOOKING/PREDICTIVE/REACTIVE WINDSHEAR SYSTEMS
Mark M. McGlinchey *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 1 Jul. 1990 p 73-81 (For primary document see N91-11682 03-03)
Avail: NTIS HC/MF A15 CSCL 01C

Forward-looking windshear systems are developing to a point (particularly the infrared sensors) where their interface with the cockpit and reactive windshear systems needs to be defined. As airlines retrofit their aircraft with reactive windshear systems, it is important to recognize that onboard windshear systems of the future will be a combination of both forward-looking and reactive elements. Today's reactive systems need to be built with the capability to interface with the forward-looking systems of tomorrow. This presentation is a first step at looking at the requirements and defining interface standards for integrated forward-looking and reactive windshear systems. Undoubtedly the requirements for interfacing these types of windshear systems will change as the technology changes. Author

N91-11686*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
HEAVY RAIN EFFECTS ON AIRPLANE PERFORMANCE
R. E. Dunham, Jr., G. M. Bezos, B. A. Campbell, W. D. Mace, Jr., and W. E. Melson, Jr. (National Aeronautics and Space Administration. Wallops Flight Facility, Wallops Island, VA.) *In its* Airborne Wind Shear Detection and Warning Systems. Second Combined Manufactuters' and Technologists' Conference, Part 1 Jul. 1990 p 85-101 (For primary document see N91-11682 03-03)
Avail: NTIS HC/MF A15 CSCL 01C

The objective is to determine if the aerodynamic characteristics of an airplane are altered while flying in the rain. Wind-tunnel tests conducted at the NASA Langley Research Center (LaRC) have shown losses in maximum lift, reduction in stall angle, and increases in drag when a wing is placed in a simulated rain spray. For these tests the water spray concentration used represented a very heavy rainfall. A lack of definition of the scaling laws for aerodynamic testing in a two-phase, two-component flow makes interpolation of the wind-tunnel test uncertain. Tests of a large-scale wing are to be conducted at the LaRC. The large-scale wing is mounted on top of the Aircraft Landing Dynamics Facility (ALDF) carriage. This carriage (which is 70-foot long, 30-foot wide, and 30-foot high) is propelled with the wing model attached down a 3000-foot long test track by a water jet at speeds of up to 170

knots. A simulated rain spray system has been installed along 500 feet of the test track and can simulate rain falls from 2 to 40 inches/hour. Operational checks are underway and the initial tests should be completed by the Fall of 1989. Author

N91-11687*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A PROPOSED DEFINITION FOR A PITCH ATTITUDE TARGET FOR THE MICROBURST ESCAPE MANEUVER
Richard S. Bray *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 1 Jul. 1990 p 105-121 (For primary document see N91-11682 03-03)
Avail: NTIS HC/MF A15 CSCL 01C

The Windshear Training Aid promulgated by the Federal Aviation Administration (FAA) defines the practical recovery maneuver following a microburst encounter as application of maximum thrust accompanied by rotation to an aircraft-specific target pitch attitude. In search of a simple method of determining this target, appropriate to a variety of aircraft types, a computer simulation was used to explore the suitability of a pitch target equal in numerical value to that of the angle of attack associated with stall warning. For the configurations and critical microburst shears simulated, this pitch target was demonstrated to be close to optimum. Author

N91-11688*# United Air Lines, Inc., Denver, CO.
THE 11 JULY 1988 DENVER WINDSHEAR ENCOUNTERS
Robert L. Ireland *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 1 Jul. 1990 p 179-187 (For primary document see N91-11682 03-03)
Avail: NTIS HC/MF A15 CSCL 01C

On July 11, 1988, between 2207 and 2213 UTC (16:07 to 16:13 MDT), four successive United flights had inadvertent encounters with microburst windshear conditions while on final approach to Denver Stapleton Airport (DEN), each resulting in a missed approach, subsequent delay, and uneventful arrival. A fifth flight executed a missed approach without encountering the phenomena. There was no damage to aircraft and no passenger injuries were incurred. The term inadvertent is used within United Airlines' windshear training materials and the Federal Aviation Administration (FAA) Windshear Training Aid to connote an encounter with windshear after vigilance and cautionary practices fail to identify and afford complete avoidance of the hazardous area. No crew culpability is implied. A comprehensive investigation for scientific purposes in the study of windshear phenomenon is being conducted separately under the guidance of the FAA with involvement and cooperation from United, the National Transportation Safety Board (NTSB), National Center for Atmospheric Research (NCAR), Boeing, Douglas, NASA, and others. Author

N91-11689*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AIRBORNE DOPPLER RADAR DETECTION OF LOW ALTITUDE WINDSHEAR
Emedio M. Bracalente, William R. Jones, and Charles L. Britt (Research Triangle Inst., Hampton, VA.) *In its* Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 1 Jul. 1990 p 211-224 Presented at the AIAA Conference on Sensor and Measurement Techniques for Aeronautical Application, Atlanta, GA, 7-9 Sep. 1988 Previously announced in IAA as A90-23284 (For primary document see N91-11682 03-03)
Avail: NTIS HC/MF A15 CSCL 01C

As part of an integrated windshear program, the Federal Aviation Administration, jointly with NASA, is sponsoring a research effort to develop airborne sensor technology for the detection of low altitude windshear during aircraft take-off and landing. One sensor being considered is microwave Doppler radar operating at X-band or above. Using a Microburst/Clutter/Radar simulation program, a preliminary feasibility study was conducted to assess the performance of Doppler radars for this application. Preliminary results from this study are presented. Analysis show, that using bin-to-bin Automatic Gain Control (AGC), clutter filtering, limited detection range, and suitable antenna tilt management, windshear from a wet microburst can be accurately detected 10 to 65 seconds (.75 to 5 km) in front of the aircraft. Although a performance improvement can be obtained at higher frequency, the baseline X-band system that was simulated detected the presence of a windshear hazard for the dry microburst. Although this study indicates the feasibility of using an airborne Doppler radar to detect low altitude microburst windshear, further detailed studies, including future flight experiments, will be required to completely characterize the capabilities and limitations. Author

N91-11690*# Clemson Univ., SC.
CLUTTER FILTER DESIGN CONSIDERATIONS FOR AIRBORNE DOPPLER RADAR DETECTION OF WINDSHEAR
Ernest G. Baxa, Jr. *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 1 Jul. 1990 p 281-294 (For primary document see N91-11682 03-03)
Avail: NTIS HC/MF A15 CSCL 01C

The problem of clutter rejection when processing down-looking Doppler radar returns from a low altitude airborne platform is a paramount problem. With radar as a remote sensor for detecting and predicting windshear in the vicinity of an urban airport, dynamic range requirements can exceed 50 dB because of high clutter to signal ratios. This presentation describes signal processing considerations in the presence of distributed and/or discrete clutter interference. Previous analyses have considered conventional range cell processing of radar returns from a rigidly mounted radar platform using either the Fourier or the pulse-pair method to estimate average windspeed and windspeed variation within a cell. Clutter rejection has been based largely upon analyzing a particular environment in the vicinity of the radar and employing a variety of techniques to reduce interference effects including notch filtering, Fourier domain line editing, and use of clutter maps. For the airborne environment the clutter characteristics may be somewhat different. Conventional clutter rejection methods may have to be changed and new methods will probably be required to provide useful signal to noise ratios. Various considerations are described. A major thrust has been to evaluate the effect of clutter rejection filtering upon the ability to derive useful information from the post-filter radar data. This analysis software is briefly described. Finally, some ideas for future analysis are considered including the use of adaptive filtering for clutter rejection and the estimation of windspeed spatial gradient directly from radar returns as a means of reducing the effects of clutter on the determination of a windshear hazard. Author

N91-11691*# Turbulence Prediction Systems, Boulder, CO.
RAMIFICATIONS OF THE RECENT FAA RULE FOR WINDSHEAR SYSTEMS ON THE DEVELOPMENT OF FORWARD-LOOKING SYSTEMS
H. Patrick Adamson *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 1 Jul. 1990 p 313-323 (For primary document see N91-11682 03-03)
Avail: NTIS HC/MF A15 CSCL 01C

The recent Federal Aviation Administration (FAA) rule requiring windshear systems with flight guidance may have severe ramifications for the development of infrared and other forward-looking systems. The industry needs to have and can have a more cost effective option through the use of a forward-looking system with a reactive backup instead of a reactive system with flight guidance. However, because of the short time for compliance with the new FAA rule, it is possible that existing transport aircraft will be in full compliance before a comprehensive investigation of all forward-looking systems can be completed. If this occurs, it is possible that the market for forward-looking systems will be severely reduced, thereby eliminating the economic incentive to develop these much needed systems. Thus, to assure that this option is available for the airlines, it beehoves the industry to

immediately support an in-service evaluation of all available forward-looking systems. Author

N91-11692*# Delco Systems Operations, Milwaukee, WI.
STATUS OF THE DELCO SYSTEMS OPERATIONS FORWARD LOOKING WINDSHEAR DETECTION PROGRAM
Brian J. Gallagher *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 1 Jul. 1990 p 331-348 (For primary document see N91-11682 03-03)
Avail: NTIS HC/MF A15 CSCL 01C

Delco Systems Operations, a division of General Motors Hughes Electronics Corporation, is developing a Forward Looking Windshear Detection System based on the integration of infrared remote sensing and accelerometer reactive sensing technologies. The infrared sensor is a multi-spectral, scanning radiometer operating in the 8 to 14 micron region. A 2 x 5 detector array with parallel-serial scanning produces 60 degrees horizontal and 10 degrees vertical-fields of view. Using multiple wavelength signals, azimuth temperature gradients are analyzed for characteristic signatures of thermally induced windshear phenomena. Elevation temperature gradients are processed through an atmosphere model to continuously compute a stability index for arming microburst detection criteria. The atmosphere model and proprietary computer processing algorithms combine to generate coarse estimates of disturbance ranges based on multiple wavelength radiance data with different extinction coefficients. Computer outputs of atmospheric stability, disturbance intensity, and azimuth and range information provide a situation display capability. A ground operated, experimental radiometer has been developed and is being used to verify the detection and discrimination concepts at an atmospheric and simulated rain test facility in Milwaukee. A prototype airborne radiometer is being developed for flight test evaluation during the summer of 1989. Author

N91-11693*# New Hampshire Univ., Durham.
INFRARED THERMAL IMAGING OF ATMOSPHERIC TURBULENCE **c47**
David Watt and John McHugh *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 1 Jul. 1990 p 349-363 (For primary document see N91-11682 03-03)
Avail: NTIS HC/MF A15 CSCL 04B

A technique for analyzing infrared atmospheric images to obtain cross-wind measurement is presented. The technique is based on Taylor's frozen turbulence hypothesis and uses cross-correlation of successive images to obtain a measure of the cross-wind velocity in a localized focal region. The technique is appealing because it can possibly be combined with other IR forward look capabilities and may provide information about turbulence intensity. The current research effort, its theoretical basis, and its applicability to windshear detection are described. Author

N91-11694*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INVESTIGATION OF AIRBORNE LIDAR FOR AVOIDANCE OF WINDSHEAR HAZARDS
Russell Targ (Lockheed Missiles and Space Co., Palo Alto, CA.) and Roland L. Bowles *In its* Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 1 Jul. 1990 p 365-377 (For primary document see N91-11682 03-03)
Avail: NTIS HC/MF A15 CSCL 01C

A generalized windshear hazard index is defined, which is derived from considerations of wind conditions at the present position of an aircraft and from remotely sensed information along the extended flight path. Candidate airborne sensor technologies based on microwave Doppler radar, Doppler lidar, and infrared radiometric techniques are discussed in the context of overall system functional requirements. Initial results of a performance and technology assessment study for competing lidars are presented. Based on a systems approach to the windshear threat, lidar appears to be a viable technology for windshear detection and avoidance, even in conditions of moderately heavy precipitation. The proposed airborne CO2 and Ho:YAG lidar windshear-detection systems analyzed here can give the pilot information about the line-of-sight component of windshear threat from his present position to a region extending 1 to 3 km in front of the aircraft. This constitutes a warning time of 15 to 45 seconds. The technology necessary to design, build, and test such a brassboard 10.6 micron CO2 lidar is now available. However, for 2-micron systems, additional analytical and laboratory investigations are needed to arrive at optimum 2-micron rare-earth-based laser crystals. Author

N91-11695*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AIRBORNE WIND SHEAR DETECTION AND WARNING SYSTEMS. SECOND COMBINED MANUFACTURERS' AND TECHNOLOGISTS' CONFERENCE, PART 2
Amos A. Spady, Jr., comp., Roland L. Bowles, comp., and Herbert Schlickenmaier, comp. (Federal Aviation Administration, Washington, DC.) Jul. 1990 452 p Conference held in Williamsburg, VA, 18-20 Oct. 1988
(NASA-CP-10050-Pt-2; NAS 1.55:10050-Pt-2) Avail: NTIS HC/MF A20 CSCL 01C

The Second Combined Manufacturers' and Technologists' Conference was hosted jointly by NASA Langley (LaRC) and the Federal Aviation Administration (FAA) in Williamsburg, Virginia, on October 18 to 20, 1988. The meeting was co-chaired by Dr. Roland Bowles of LaRC and Herbrt Schlickenmaier of the FAA. The purpose of the meeting was to transfer significant, ongoing results gained during the second year of the joint NASA/FAA Airborne Wind Shear Program to the technical industry and to pose problems of current concern to the combined group. It also provided a forum for manufacturers to review forward-look technology concepts and for technologists to gain an understanding of the problems encountered by the manufacturers during the development of airborne equipment and the FAA certification requirements. For individual titles, see N91-11696 through N91-11705.

N91-11696*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FLIGHT GUIDANCE RESEARCH FOR RECOVERY FROM MICROBURST WIND SHEAR
David A. Hinton *In its* Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 2 Jul. 1990 p 395-416 (For primary document see N91-11695 03-03)
Avail: NTIS HC/MF A20 CSCL 01C

Research is in progress to develop flight strategy concepts for avoidance and recovery from microburst wind shears. The objectives of this study are to evaluate the performance of various strategies for recovery from wind shear encountered during the approach-to-landing, examine the associated piloting factors, and evaluate the payoff of forward-look sensing. Both batch and piloted simulations are utilized. The industry-recommended manual recovery technique is used as a baseline strategy. Two advanced strategies were selected for the piloted tests. The first strategy emulates the recovery characteristics shown by prior optimal trajectory analysis, by initially tracking the glideslope, then commanding a shallow climb. The second strategy generates a flight path angle schedule that is a function of airplane energy state and the instantaneous shear strength. All three strategies are tested with reactive sensing only and with forward-look sensing. Piloted simulation tests are in progress. Tentative results indicate that, using only reactive alerts, there appears to be little difference in performance between the various strategies. With forward-look alerts, the advanced guidance strategies appear to have advantages over the baseline strategy. Relatively short forward-look alert times, on the order of 10 or 15 seconds, produce a far greater recovery benefit than optimizing a recovery from a reactive alert. Author

N91-11697*# Honeywell, Inc., Phoenix, AZ. Sperry Commercial Flight Systems Group.
ANALYSIS OF GUIDANCE LAW PERFORMANCE USING PERSONAL COMPUTERS
J. Rene Barrios *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 2 Jul. 1990 p 471-484 (For primary document see N91-11695 03-03)
Avail: NTIS HC/MF A20 CSCL 01C

A point mass, three-degree of freedom model is presented as a basic development tool for PC based simulation models. The model has been used in the development of guidance algorithms as well as in other applications such as performance management systems to compute optimal speeds. Its limitations and advantages are discussed with regard to the windshear environment. A method for simulating a simple autopilot is explained in detail and applied in the analysis of different guidance laws. Author

N91-11698*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
AN EXPERT SYSTEM FOR WIND SHEAR AVOIDANCE
Robert F. Stengel and D. Alexander Stratton *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 2 Jul. 1990 p 515-544 (For primary document see N91-11695 03-03)
Avail: NTIS HC/MF A20 CSCL 01C

The principal objectives are to develop methods for assessing the likelihood of wind shear encounter (based on real-time information in the cockpit), for deciding what flight path to pursue (e.g., takeoff abort, landing go-around, or normal climbout or glide slope), and for using the aircraft's full potential for combating wind shear. This study requires the definition of both deterministic and statistical techniques for fusing internal and external information, for making go/no-go decisions, and for generating commands to the aircraft's autopilot and flight directors for both automatic and manually controlled flight. The expert system for pilot aiding is based on the results of the FAA Windshear Training Aids Program, a two-volume manual that presents an overview, pilot guide, training program, and substantiating data that provides guidelines for this initial development. The Windshear Safety Advisor expert system currently contains over 140 rules and is coded in the LISP programming language for implementation on a Symbolics 3670 LISP Machine. Author

N91-11699*# Honeywell, Inc., Phoenix, AZ. Sperry Commercial Flight Systems Group.
THE EFFECT OF WINDSHEAR DURING TAKEOFF ROLL ON AIRCRAFT STOPPING DISTANCE
Terry Zweifel *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 2 Jul. 1990 p 547-561 (For primary document see N91-11695 03-03)
Avail: NTIS HC/MF A20 CSCL 01C

A simulation of a Boeing 727 aircraft during acceleration on the runway is used to determine the effect of windshear on stopping distance. Windshears of various magnitudes, durations, and onset times are simulated to assess the aircraft performance during an aborted takeoff on five different runway surfaces. A windshear detection system, active during the takeoff roll and similar to the Honeywell Windshear Detection System is simulated to provide a discrete system to activate aircraft braking upon shear detection. The results of the simulation indicate that several factors effect the distance required to stop the aircraft. Notable among these are gross weight, takeoff flap position, runway characteristics, and pilot reaction time. Of the windshear parameters of duration, onset and magnitude, magnitude appears to have the most significant effect. Author

N91-11700*# Direction Generale de L'Aviation Civile, Toulouse (France).
WIND SHEAR PREDICTIVE DETECTOR TECHNOLOGY STUDY STATUS
C. Gandolfi *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 2 Jul. 1990 p 592-637 (For primary document see N91-11695 03-03)
Avail: NTIS HC/MF A20 CSCL 01C

Among the different elements to be investigated when considering the Wind Shear hazard, the Aeronautical Navigation Technical Service (STNA/3E), whose task is to participate in the development of new technologies and equipments, focused its effort on airborne and ground sensors for the detection of low-level wind shear. The first task, initiated in 1986, consists in the evaluation of three candidate techniques for forward-looking sensors: lidar, sodar, and radar. No development is presently foreseen for an infrared based air turbulence advance warning system although some flight experiments took place in the 70's. A Thomson infrared radiometer was then installed on an Air France Boeing 707 to evaluate its capability of detecting clear air turbulence. The conclusion showed that this technique was apparently able to detect cloud layers but that additional experiments were needed; on the other hand, the rarity of the phenomenon and the difficulty in operating on a commercial aircraft were also mentioned. Author

N91-11701*# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
SUMMER 1988 TDWR MICROBURST ANALYSIS
Mark W. Merritt *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 2 Jul. 1990 p 740-751 (For primary document see N91-11695 03-03)
Avail: NTIS HC/MF A20 CSCL 01C

The Terminal Doppler Weather Radar (TDWR) testbed system was operated during the months of July to August 1988 in a live operational demonstration providing microburst (and related weather hazard) protection to the Stapleton International Airport in Denver, CO. During this time period, the performance of the detection system was carefully monitored in an effort to determine the reliability of the system. Initial performance analysis indicates that the microburst detection component of TDWR satisfies the basic performance goals of 90 percent probability of detection and 10 percent probability of false alarm. An in-depth study of the system performance, based on analysis of both dual-Doppler radar observations and surface mesonet measurements, is in progress to provide a detailed understanding of the observability of microbursts by the radar, the ability of the algorithms to detect microburst observed by the radar, and the timeliness and accuracy of the microburst alarms provided to operational users. Author

N91-11702*# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
AUTOMATIC DETECTION OF LOW ALTITUDE WIND SHEAR DUE TO GUST FRONTS IN THE TERMINAL DOPPLER WEATHER RADAR OPERATIONAL DEMONSTRATION
Diana Klingle-Wilson *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 2 Jul. 1990 p 754-770 (For primary document see N91-11695 03-03)
Avail: NTIS HC/MF A20 CSCL 01C

A gust front is the leading edge of the cold air outflow from a thunderstorm. Wind shears and turbulence along the gust front may produce potentially hazardous conditions for an aircraft on takeoff or landing such that runway operations are significantly impacted. The Federal Aviation Administration (FAA) has therefore determined that the detection of gust fronts in the terminal environment be an integral part of the Terminal Doppler Weather Radar (TDWR) system. Detection of these shears by the Gust Front Algorithm permits the generation of warnings that can be issued to pilots on approach and departure. In addition to the detection capability, the algorithm provides an estimate of the wind speed and direction following the gust front (termed wind shift) and the forecasted location of the gust front up to 20 minutes before it impacts terminal operations. This has shown utility as a runway management tool, alerting runway supervisors to

approaching wind shifts and the possible need to change runway configurations. The formation and characteristics of gust fronts and their signatures in Doppler radar data are discussed. A brief description of the algorithm and its products for use by Air Traffic Control (ATC), along with an assessment of the algorithm's performance during the 1988 Operational Test and Evaluation, is presented. Author

N91-11703*# Air Line Pilots Association, International, Washington, DC.
WIND SHEAR PROCEDURES AND THE INSTRUMENTATION
W. W. Melvin *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 2 Jul. 1990 p 798-808 (For primary document see N91-11695 03-03)
Avail: NTIS HC/MF A20 CSCL 01C

The effect of pitch rate on abort landing caused by wind shear encounters is discussed. Optimal trajectories, airspeed, and wind shear warning systems are briefly discussed. The bulk of the presentation is in viewgraph form. Author

N91-11704*# Airbus Industrie, Blagnac (France).
AIRBUS WINDSHEAR WARNING AND GUIDANCE SYSTEM
J. L. Bonafe *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 2 Jul. 1990 p 811-834 (For primary document see N91-11695 03-03)
Avail: NTIS HC/MF A20 CSCL 01C

From its first designed airplane, Airbus considered mandatory a help in the crew's decision-making process to initiate an escape maneuver and help to successfully realize it. All the Airbus airplanes designed since 1975 included an alpha-floor function and a speed reference control law imbedded in the speed reference system (SRS) box for A 300 and FAC and FCC for A 310, A300/600 and the A 320. Alpha-Floor function takes into account the airplane energy situation considering angle of attack and observed longitudinal situation in order to apply immediately the full power without any pilot action. Speed reference managers control airspeed and/or ground speed in order to survive a maximum in shear situation. In order to comply with the new FAA regulation: Aerospatiale and Airbus developed more efficient systems. A comparison between 1975 and a newly developed system is given. It is explained how the new system improves the situation. Author

N91-11705*# Spectra Technology, Inc., Bellevue, WA.
THE WINDVAN PULSED CO2 DOPPLER LIDAR WIDE-AREA WIND SENSOR **c36**
Rhidian Lawrence *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 2 Jul. 1990 p 835-842 (For primary document see N91-11695 03-03)
Avail: NTIS HC/MF A20 CSCL 20E

Wind sensing using a Doppler lidar is achieved by sensing the Doppler content of narrow frequency laser light backscattered by the ambient atmospheric aerosols. The derived radial wind components along several directions are used to generate wind vectors, typically using the Velocity Azimuth Display (VAD) method described below. Range resolved information is obtained by range gating the continuous scattered return. For a CO2 laser (10.6 mu) the Doppler velocity scaling factor is 188 kHz/ms(exp -1). In the VAD scan method the zenith angle of the pointing direction is fixed and its azimuth is continuously varied through 2 pi. A spatially uniform wind field at a particular altitude yields a sinusoidal variation of the radial component vs. azimuth. The amplitude, phase and dc component of this sinusoid yield the horizontal wind speed, direction and vertical component of the wind respectively. In a nonuniform wind field the Fourier components of the variation yields the required information. Author

N91-11706# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.
OCCUPANT CRASH PROTECTION IN MILITARY AIR TRANSPORT
Richard F. Chandler Aug. 1990 151 p
(AGARD-AG-306; ISBN-92-835-0579-4) Copyright Avail: NTIS HC/MF A08; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The progress is traced of developments in seat and restraint systems for passengers in all types of aircraft. Results of carefully directed studies from the 1940's through current times leading to today's state of the art are reported as are specifications and regulations which were developed. An extensive bibliography provides the sources of reports necessary for a reader who wishes to make an indepth study of the technology. Author

N91-11707# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Bonn (Germany, F.R.).
EUROPEAN FORUM: THE EVOLUTION OF REGIONAL AIRCRAFT TECHNOLOGIES AND CERTIFICATION
1989 201 p Forum held in Friedrichshafen, Fed. Republic of Germany, 6-7 Apr. 1989; sponsored by DGLR, AAAF, and RAeS Sponsored by BMFT
(DGLR-Bericht-89-02; ISBN-3-922010-45-8; ETN-90-97835)
Avail: NTIS HC/MF A10

The evolution of aircraft technology and certification to a joint European approach was discussed. Competition with high speed railways was considered. New technologies included the use of composite materials, particularly carbon fiber reinforced plastic wings, and information systems. Noise reduction research is reported. Turbofan and propfan technologies are addressed. Passenger and airline requirements are covered. For individual titles, see N91-11708 through N91-11737.

N91-11708# European Regional Airlines Organization, Chobham (England).
REGIONAL AIR TRAFFIC AFTER 1992
Mike A. Ambrose *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 5-8 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

Some thoughts on regional air traffic assuming the completion of a fully liberalized air transport system by January 1993 are offered. Major factors which will influence traffic characteristics including the nature of the liberalization, airport and air traffic control infrastructure and congestion levels, advances in technology and changes in air transport economics, are reviewed. ESA

N91-11709# Bundesministerium fuer Verkehr, Bonn (Germany, F.R.).
HIGH-SPEED TRAINS IN COMPETITION WITH REGIONAL AIR TRANSPORT
Peter Reinhardt *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 9-20 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

Concepts developed to encounter loss of passengers in short and long distance railway transport are discussed. High speed railway transport in Europe, particularly France and the Federal Republic of Germany, is described. Improvements in rolling material and a list of future traveling times with time saved are given. The reasons for choice between traveling methods are outlined. ESA

N91-11710# British Aerospace Commercial Aircraft, Hatfield (England).
NEXT GENERATION OF REGIONAL AIRCRAFT
Alan A. Blythe *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 21-25 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

The current situation with regard to regional airliners is reviewed, focusing on aircraft designed primarily for this market. Future market

prospects, together with candidate powerplants for the next generation aircraft are considered. Objectives for the next generation regional airliners are identified. Needs with regard to safety, operating flexibility, operating costs, reliability, comfort standard, field performance and noise are discussed. Potential contenders for the next generation of regional airliners are reviewed. ESA

N91-11711# Aerospatiale, Toulouse (France).
TOWARDS A SINGLE CERTIFICATION ACTION WITHIN EUROPE
J. Viargues and J. Javelle *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 27-31 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

The airworthiness and certification concepts and the development and the objectives of the European regulations are reviewed. Examples of the application of the European regulations and the different procedures used, and the lessons to be learnt from these experiences are presented. Future developments concerning regulations and procedures are presented. ESA

N91-11712# Saab-Scania, Linkoping (Sweden). Ground and Flight Test Dept.
EXPERIENCES GAINED IN THE SF340 AIRWORTHINESS PROCESS
Milton Mobarg *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 33-35 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

An introduction to the Swedish company SAAB-Scania's background as an aircraft manufacturer, commencing in the late thirties, is given. The significant stages of the SF340 program are discussed. Emphasis is given to the airworthiness and certification aspects of the program. ESA

N91-11713# Fokker B.V., Schipol-Oost (Netherlands).
FOKKER 50: TECHNOLOGY VERSUS CERTIFICATION EXPERIENCE
R. W. Bishop *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 37-46 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

With accompanying illustrations, the Fokker 50 program is described. The Fokker 50 was awarded a type certificate on the 15th May 1987, ending a development program launched in November 1983. The aircraft, which started life as a re-engined derivative of the F27 Mk 500, evolved into a state of the art turboprop airliner making full use of current technology. A major part of the program was an update of the certification base, achieved in close cooperation with the Dutch civil aviation authority. Experience gained during the development process generally confirmed the need for direct interaction between the technology adopted and the evolving basis for certification. ESA

N91-11714# Aerospatiale, Toulouse (France). Aircraft Div.
ATR 72: THE FIRST CIVIL AIRCRAFT WITH A CARBON FIBRE REINFORCED PLASTIC WING **c05**
B. Medda *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 47-51 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

The equipping of ATR 72 commuters with an outer wing in carbon fiber reinforced plastic is addressed. The structural design and two specific criteria for certification, impact resistance and lightning behavior of this composite wing box, are described. Comparative tests between composite structures and their metallic counterparts showed a better behavior of the composite part under lightning and hail strikes. The experience gained makes it possible for the production of a larger wing box for a 100 to 200 seater aircraft to be envisaged. ESA

N91-11715# British Aerospace Public Ltd. Co., Woodford (England).
THE CERTIFICATION OF THE AVIONIC SYSTEMS ON THE ATP TO JAR 25 **c06**
J. A. Shimmin *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 53-61 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

The use of digital avionic systems including an Electronic Flight Instrument System (EFIS) in the design of the Advanced Turbo Prop aircraft is described. The certification process used for the EFIS, the software of the digital systems, and the lightning protection of the aircraft are described. The method used to show compliance with Joint Aviation Requirement 25.1309 is described. ESA

N91-11716# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
DORNIER 328: TECHNOLOGY VERSUS CERTIFICATION ASPECTS OF PROGRAM PHILOSOPHY
R. Birrenbach *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 63-72 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

Type certification aspects and operational effects of the Dornier 328 program are discussed. New technologies are applied where experience is available, risk affordable and attractive operating costs are shown. The application of composite material is burdened by cost and time. Aluminum-lithium sheet metal is delayed because production is not yet reasonably established. Requirements on flammability, smoke emission and toxic gas emission demands new material for cabin/cockpit interiors. Advancement in microelectronics and modern airliner in service experience prepare the way for integrated digital avionic installation in regional airlines. ESA

N91-11717# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
INTERIOR NOISE CONTROL PROGRAM FOR THE ADVANCED COMMUTER AIRCRAFT DORNIER 328 AND FIRST RESULTS **c71**
I. U. Borchers, H. J. Hackstein, M. Gruenewald, and C. Weigwieser *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 73-83 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

A noise control program is described and related first results are presented. Experimental results include selected test data of systematic transmission loss and noise reduction measurements performed on different aircraft fuselage panels and a full scale Dornier 328 test section, respectively. Theoretical results comprise vibration analysis data of fuselage sections of different designs as well as interior noise and related noise reduction spectra predicted for the full scale fuselage test section and the overall aircraft cabin structure. The results were obtained using a finite element code and a propeller interior noise program. Results are in good agreement and provide important inputs for an acoustical tuning of the fuselage structure. Information on the complex vibro-acoustic behavior of the aircraft cabin cavity and the fuselage structure is provided. ESA

N91-11718# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Technical Acoustics Div.
DLR AIRCRAFT NOISE RESEARCH AND TESTING TECHNIQUES RELATED TO PROPELLER DRIVEN AEROPLANE NOISE CERTIFICATION **c71**
Hanno Heller and Werner Dobrzynski *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 85-96 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

The development of certification procedures relies heavily on the results of aircraft noise research involving flight tests, and full scale and model scale wind tunnel tests. The most recent versions

of the relevant noise certification procedures for regional aircraft, specifically for so called heavy and light propeller driven airplanes, are discussed. Relevant research in the area of propeller noise generation and radiation is described and an outlook on advanced technology propulsion systems (specifically the propfan) and the problems likely to be encountered in establishing corresponding noise certification procedures and noise limits is given. ESA

N91-11719# Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany, F.R.).
AIRCRAFT ENGINE NOISE **c71**
F. Kennepohl *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 97-104 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

An overview of the main aircraft engine noise sources is given. Special emphasis is devoted to turbomachinery/rotor noise, which plays an important role in all engine concepts appropriate to regional aircraft, such as turbofans, propellers, or new propfan engine concepts. The noise generating mechanisms, including propagation within the engine, and calculation methods used are described. Noise reduction methods are considered, with emphasis on cutoff design of turbomachines. Some noise features of counter rotating propellers and swept rotor blades are mentioned. ESA

N91-11720# Cranfield Inst. of Tech., Bedford (England). Coll. of Aeronautics.
A PASSENGER'S VIEW OF COMMUTER AIRCRAFT
A. N. Hofton *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 105-11 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

Passenger's views of commuter aircraft are considered. The fact that passengers seek inconsistent combinations of service features such as frequency, load factor, aircraft size and fare levels and that the task of the designer and airline manager are particularly difficult is acknowledged. The study draws on personal experience and on the results of surveys of passengers, to highlight the areas where passengers seek improvements. It is concluded that users require more space per passenger, more cabin stowage space and lower cabin noise levels. Growing congestion means that all commuter aircraft should be capable of operating from secondary runways. More customer research is suggested as being needed before new designs are frozen. ESA

N91-11721# Aerospatiale, Suresnes (France).
THE EVOLUTION OF REGIONAL AIR TRAFFIC **c04**
Danielle Kahan *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 111-11 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

Analysis of the regional market growth including historical evolution and evolving legal framework is presented. The European market characteristics regarding stage length, block time, frequency and network are described. Analysis of the possible trends taking into account the influence of airport and airline policies and passenger standpoint is carried out. Analysis shows a great potential for the European regional market in particular and indicates a wide range of requirements to meet that demand. ESA

N91-11722# Airport Authority, Munich (Germany, F.R.).
REGIONAL AIR TRAFFIC INTO INTERNATIONAL AIRPORTS: THE DEVELOPMENT IN REGIONAL AIR TRAFFIC **c04**
P. Trautmann and C. Parau *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 117-12 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

The development of regional air traffic, defined as the sector of aviation which increases the density of the domestic and international scheduled air traffic network with the aim of developing the area covered by the network, is described. It normally employs modern turboprop aircraft, but the jump to the jet age is already planned. It differs greatly between countries. Its main hope of survival lies in the exploitation of gaps in the market and a careful tactical approach when dealing with the large passenger airline companies. ESA

N91-11723# Eurocontrol Agency, Brussels (Belgium).
AIR TRAFFIC CONTROL ASPECTS FOR THE TIME BEYOND 1992 **c04**
Hansjuergen vonVilliez *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 121-12 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

Problem areas and potential solutions concerning human resources, airspace structure and complexity, air traffic control and system support are analyzed. Common Medium Term Plan of the Eurocontrol organization is recalled. Its communal goal of harmonization of development and integration of air traffic control are emphasized. ESA

N91-11724# Deutsche Luftverkehrsgellschaft m.b.H., Frankfurt (Germany, F.R.).
MAINTAINABILITY OF REGIONAL AIRCRAFT **c01**
W. Hergesell *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 127-12 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

The influences of aircraft size and technology are discussed. It is suggested that the maintainability is affected by the philosophy of the aircraft manufacturer and the design and by the following factors: size of the aircraft; technology used in the aircraft and their systems; age of the aircraft (e.g., hours since new/cycles since new); complexity of the installed engines and systems; qualification of maintenance personnel and inspectors required; special tools and their availability; sophisticated test equipment; size of hangars and other facilities; choosen maintenances systems; reliability monitoring; product and material support by manufacturers; product improvement by manufacturers; and feedback of operator's experience to manufacturers. ESA

N91-11725# Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany, F.R.).
ENGINE MAINTAINABILITY: OBJECTIVES AND METHODS **c07**
A. Senft *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 129-13 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

Major considerations used to improve engine maintainability are identified. The basis for maintainability features are a lot of requirements. These requirements are defined by the customer and created using several analyses. Criteria for good maintainability features of an engine are considered to be design requirements. The engine shall be designed for ease and simplicity of maintenance. Modular concept and quantitative/qualitative design targets are necessary to meet specified requirements. Maintainability reviews and maintainability demonstrations have to be conducted during engine development to show that the requirements given have been met. ESA

N91-11726# Groupement d'Interest Economique, Cergy-Saint Christophe (France).
NEW TECHNOLOGIES AND CUSTOMER ACCEPTANCE **c05**
E. Pavard *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 133-13 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

The reasons pushing aircraft manufacturers towards new technologies and the acceptance of such technologies by regional airlines are considered. Some specifics of the commuter market with regard to this acceptance are described. Precise examples based on experience gained during the design phase and marketing of the ATR 42 and ATR 72, which are recognized new technology commuterliners, are given. These examples include the Electronic

Flight Instrument System cockpit, composite materials on primary and secondary structures, and carbon brakes. These examples show that, as a general rule, novel techniques are well accepted provided that the real benefits can be properly substantiated by the manufacturer. ESA

N91-11727# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Entwurfsaerodynamik.
LAMINAR FLOW WING **c02**
G. Redeker *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 137-14 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

Laminar flow technology is one of the promising means to improve the performance of aircraft. With long laminar boundary layers on wing surfaces and on other aircraft components, the skin friction and thereby the drag is reduced considerably. The state of the art of designing laminar flow airfoils and wings for higher Reynolds numbers, applicable to commuter or transport aircraft is described and an indication of the drag reduction by applying this technology is given. ESA

N91-11728# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (Germany, F.R.). Fatigue and Fracture Mechanics Dept.
FULL SCALE FATIGUE AND DAMAGE TOLERANCE TESTING OF MODERN TRANSPORT AIRCRAFT **c05**
H.-J. Schmidt and B. Brandecker *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 147-15 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

The essential aspects of major full scale fatigue and damage tolerance tests for metallic structure are described using the Airbus A320 example. Details about test philosophy, test load program, test execution and supporting coupon testing are given, which comprises more than 15 years experience of fatigue and damage tolerance testing for metallic structure of aircraft and the results of numerous discussions with European and other airworthiness authorities. Specific aspects of regional aircraft full scale testing are discussed with respect to definition of test specimen, test speed, simplification of test spectrum and justification of repairs. ESA

N91-11729# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Bonn (Germany, F.R.).
DIGITAL GLASS COCKPIT FOR COMMUTER AIRCRAFT **c06**
Horst Kister *In its* European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 157-168 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

The evolution of cockpit information systems is described and an outlook on future generation smaller and more cost and weight sensitive aircrafts is derived. Systems architecture and display formats are described. The A-310 and A-320 systems were addressed. ESA

N91-11730# Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany, F.R.).
PROPFAN TECHNOLOGY **c07**
M. Dupslaff, P. Wehlitz, and P. Schimming *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 169-17 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

The main objective in recent engine development is to combine the efficiency of the propeller with the advantages of the turbofan. In this context, the shrouded propfan-concept Counter Rotating Integrated Shrouded Propfan (CRISP) was introduced, followed by the aerodynamic design consideration for its scale model. Preliminary results of aerodynamic fan experiments, which were part of the experimental program, provide the decisive new technologies for this shrouded fan concept, and encourage further activity in this direction towards the development of a new generation of jet engines. ESA

N91-11731# Rolls-Royce Ltd., Derby (England).
THE PLACE FOR THE TURBOFAN ENGINE IN THE REGIONAL AIRLINES **c07**
P. Simpkin *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 173-17 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

The historical situation and a case for the turbofan are presented. A turbofan is described, which is a cost effective powerplant for regional and feeder aircraft designed for cruise speeds of 350 kts and above, and requiring jet standard of comfort. ESA

N91-11732# Aerospatiale, Toulouse (France).
CHOICE OF PROPULSION FOR NEXT GENERATION AIRCRAFT **c07**
Robert Hinsinger *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 181-18 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

For three sizes of commuter aircraft for the next decade (30, 60, 90 seaters), different types of propulsion are considered: modern propellers, where Mach number (M) is greater than 0.5 and less than 0.6; open rotor systems where M is greater than 0.7 and less than 0.78; ducted propellers where M = 0.78, and turbofan where M = 0.78. Requirements are defined for each aircraft category. An optimization is done to minimize the operating cost. The results are provided versus number of seats and range. ESA

N91-11733# Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany, F.R.).
REQUIREMENTS FOR TURBOPROP AND TURBOFAN ENGINES IN REGIONAL AIRCRAFT **c07**
H. E. Groenewald and E. Wuerzinger *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 189-19 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

The various applications of turboprop and turbofan engines in regional aircraft are explained. Reference is made to the differing performance objectives for these aircrafts. It is shown that, in the adaptation of the engine to the aircraft, the climb phase of flight is the most significant factor for engine dimensioning. Areas of development emphasis from the point of view of market requirements are discussed with regard to their impact on design. It is shown that engines of simple design with low mechanical and thermal stressing of components but with high component efficiencies form the ideal basis for regional aircraft propulsion. This concept is seen to provide for low procurement and maintenance costs. ESA

N91-11734# Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany, F.R.).
PW300: POWERPLANT FOR REGIONAL AIRCRAFT **c07**
R. Hill *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 195-19 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

The PW300, a modern high bypass turbofan, is addressed. It will initially have a takeoff thrust of about 22 KN (5,000 Lbf) and compared to existing turbofans of this class will offer up to a 20 percent reduction in specific fuel consumption. A technical description of each engine component is given as well as an explanation of how the exceptional performance is achieved. The growth potential and derivative versions of the engine are discussed. ESA

N91-11735# Civil Aviation Authority, London (England).
THE EUROPEAN CERTIFICATION PROCESS
R. Ashford *In* DGLR, European Forum: The Evolution of Regional

Aircraft Technologies and Certification 1989 p 201-20 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

The European certification process developed by the Joint Aviation Authorities (JAA) is described against the background of the total JAA activity. The progress from developing common regulations in the 1970s to the present arrangements for joint certification and maintaining continued airworthiness throughout the lifetime of the aircraft is summarized. The relationship of this work to the European Civil Aviation Conference (ECAC) and the European community is discussed. It is suggested that this developing JAA certification activity meets the legitimate needs of the European and worldwide aircraft manufacturing and operating industry. ESA

N91-11736# Swedish Civil Aviation Administration, Stockholm. Flight Safety Dept.
THE CERTIFICATION OF THE SAAB 340
Ingmar Hedblom *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 207-21 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

The procedures used to certify the SAAB SF 340 commuter airplane are described. The certification was the first effort to jointly certify an airplane by all the Joint European Airworthiness Authorities. Examples of major issues in the process are given. ESA

N91-11737# Luftfahrt-Bundesamt, Brunswick (Germany, F.R.).
CERTIFICATION PROCESS FOR AEROPLANE TYPE DORNIER DO 328
Klaus Koplin *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 211-21 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

A joint European team was set up for the first time to carry out certification of the new airplane type Do 328. This team shall determine for all of the 12 European Aviation Authorities that the requirements for certification are met. The duties of this team as well as of the other bodies involved in the joint certification process are described. ESA

N91-11738# Federal Aviation Administration, Washington, DC.
LOCATION OF COMMERCIAL AIRCRAFT ACCIDENTS/INCIDENTS RELATIVE TO RUNWAYS Final Report
Robert E. David 1 Jul. 1990 85 p
(AD-A225225; DOT/FAA/AOV-90-1) Avail: NTIS HC/MF A05 CSCL 01/2

The location of an aircraft involved in an accident or incident may be documented by the National Transportation Safety Board and the Federal Aviation Administration during the course of their investigation. When available, it will appear in the record of the individual investigation. However, this location information is not available from either of these agencies in a summary form. Compiled in this document is the location relative to the runway of these accidents/incidents for aircraft involved in commercial air transportation in the United States. Accidents/incidents that occurred from 1978 to 1987 were studied. Since it is intended that this information will be used mainly to make decisions on individual airports, no attempt was made to reach conclusions or make recommendations based on the data. The accidents/incidents used were categorized as undershoots, landings off the runway, veeroffs, overruns, and other in the vicinity of the airport. The aircraft location was recorded in terms of the distance along the runway centerline or extended centerline (X distance) and the perpendicular distance from the centerline or extended centerline (Y distance). GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N91-11739# Analytic Sciences Corp., Reading, MA.
ENHANCEMENT OF THE OMEGA SYSTEM AVAILABILITY ALGORITHM Final Report, Jul. 1989 - Mar. 1990
Peter B. Morris Mar. 1990 62 p
(Contract DTCG23-89-C-20008)
(AD-A224814; TASC-TIM-5834-1-1; USCG/ONSCEN-01-90)
Avail: NTIS HC/MF A04 CSCL 17/7

Enhancement of the Omega System Availability Model is presented which: (1) widen the range of application of the model; (2) increase the efficiency fo the model algorithm; and (3) broaden the model to include more realistic characterization of the signal coverage parameters. The system availability model/algorithm is modified to apply at the geographic area unit (cell) and multi-cell level. Further modifications include: a precomputation method to speed calculation and extension of the coverage database (interpolation) from four months to twelve months. The system availability model is extended to include the effects of random signal and noise variations. The augmented model structure is consistent with probabilistic definition of the Omega System Availability Index (PSA). GRA

N91-11740# Technische Univ., Brunswick (Germany, F.R.). Inst. fuer Verkehr, Eisenbahnwesen und Verkehrssicherung.
UTILIZATION OF A TESTING UNIT FOR THE EXAMINATION OF SSR MODE S, FOLLOWING A TCAS PRESENTATION [EINSATZ EINER MESSANLAGE ZUR UNTERSUCHUNG VON SSR MODE S ANLAESSLICH EINER TCAS PRAENSENTATION]
Wolfgang Detlefsen and Roland Mallwitz Apr. 1990 44 p In GERMAN
(ETN-90-97891) Avail: NTIS HC/MF A03

The number of moves in air space is continually increasing. Therefore, conventional concepts of flight safety and the existing air space structures have reached their limits. New forms of guidance and supervision of the air traffic are required, such as Secondary Surveillance Radar (SSR) and the Threat Alert and Collision Avoidance Systems (TCAS). Methods are developed which, on the one hand, describe the behavior simulated board and ground appliances in real traffic sequence, and, on the other hand, allow to simulate and analyze basic functions of the system, onboard and on ground in real environment. ESA

N91-11741# Technische Univ., Brunswick (Germany, F.R.). Inst. fuer Verkehr, Eisenbahnwesen und Verkehrssicherung.
REPORT ON THE STATE OF STANDARDIZATION OF MODE S, AND MODE S APPLICATIONS [BERICHT ZUM STAND DER STANDARDISIERUNG VON MODE S UND MODE S ANWENDUNGEN]
Klaus-Peter Berg May 1990 122 p In GERMAN
(ETN-90-97892) Avail: NTIS HC/MF A06

The examinations presented are based on the analysis of recorded real traffic sequences. The exploitation of input data and the associated data preparation are illustrated. The traffic distribution is examined within the coverage of various sensors. Starting with the geographical and temporary distribution, the obstacle loads inside the radar stream are determined, so that first conclusions on the charge of future mode S sensor can be deduced. These real in-beam distributions are extracted as input data, in order to assess various processes of the roll call scheduling. After examination of basic processes an optimal algorithm is developed. The processes are evaluated and tested, using synthetic and real traffic sequences. A simulation is presented to determine the time budget required for surveillance transactions. The fixing

of mode S data links in the ATN (Aeronautical Telecommunication Network) is represented. It allows the general concept to be drafted. Mode S subnetwork, and a conversion in mode S internal data formats are discussed. The efficiency reduction resulting from the ATN concept is examined. The mode S specific communication formats are stated in order to discuss the requirements for mode S duties. ESA

N91-11742# European Space Agency, Paris (France).
TESTING OF A GPS RECEIVER
Karlheinz Hurrass (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) Aug. 1990 42 p Transl. into ENGLISH of Erprobung eines GPS-Empfaengers (Brunswick, Fed. Republic of Germany, DFVLR), Oct. 1988 43 p Original language document was announced as N89-25145
(ESA-TT-1146; DFVLR-Mitt-88-30; ETN-90-98005) Avail: NTIS HC/MF A03

The results of the tests performed on the Global Positioning System (GPS) since the seventies are reported. In 1986, 7 satellites were available for research purposes. The accuracy of the GPS was tested. A Litton LTN-700 receiver suitable for the C/A code was used. The reference flight paths were determined by the avionics flight evaluation system. The position errors measured consisted of high frequency and low frequency noise. The standard deviation of the latter was about 30 meters. ESA

N91-11743# Federal Aviation Administration, Washington, DC. Office of Aviation Policy and Plans.
TERMINAL AREA FORECASTS: FY 1990-2005
Jul. 1990 526 p
(AD-A225227; FAA-APO-90-6) Avail: NTIS HC/MF A23 CSCL 01/5

Forecasts are presented of aviation activity of 854 airports in the U.S. for fiscal years 1990 to 2005. These include 398 airports with FAA air traffic control towers and radar approach control service and 17 FAA contract towers. For each airport, detailed forecasts are made for the four major uses of the air traffic system: air carriers, air taxi/commuters general aviation, and military. Summary tables contain national, FAA regional, and State aviation data and other airport specific highlights. The forecasts were prepared to meet the budget and planning needs of the FAA and to provide airport-specific information that can be used by State and local aviation authorities, the aviation industry, and the general public. GRA

N91-11744# Royal Air Force Coll., Cranwell (England). Dept. of Electrical and Electronic Engineering.
A REVIEW OF NAVIGATIONAL TECHNIQUES EMPLOYED IN CRUISE MISSILES AND A PROPOSED ALTERNATIVE SOLUTION M.S. Thesis
D. J. Young 1990 167 p Prepared in cooperation with Loughborough Univ. of Technology, England
(ETN-90-98219) Copyright Avail: NTIS HC/MF A08

The current navigational techniques available for use in the present generation of strategic cruise missiles are studied. The NAVSTAR Global Positioning System (GPS) and its possible integration with an Inertial Navigation System (INS), using a multi state Kalman filter, is described. The use of an integrated GPS/INS produced a navigational system that is capable of providing positional data in X, Y, and Z planes to a high degree of accuracy. Proposals are made to utilize this positional knowledge in a future cruise missile, to enable it to terrain follow and terminally guide with no external sensors operating, hence, reducing the missiles chances of detection. Simulation results suggest that such a cruise missile would be able to fly lower than the present generation of missiles, while maintaining a safe separation from the ground and a similar terminal accuracy to the current active cruise missiles. ESA

N91-11745# Cranfield Inst. of Tech., Bedford (England). Center for Transport Studies.
THE IMPACT OF EXCHANGE RATES ON AIR TRAFFIC DEMAND M.S. Thesis
T. J. Patch Sep. 1990 161 p
(ETN-90-98220) Copyright Avail: NTIS HC/MF A08

A study to identify the principal factors explaining air traffic demand on two long and two short haul routes, between the United Kingdom and Switzerland is presented. Particular attention is paid to analyzing the influence of exchange rates on traffic levels in each market segment on each route. Exchange rates alone are seen to be an inadequate explanatory variable, and the interrelationship between exchange rates and relative inflation rates is considered. The role of leads and lags in the relationship between air traffic and exchange rates adjusted by inflation is analyzed. The variables affecting air traffic and the specific characteristics of the routes concerned are reviewed. Econometric models are developed using multiple regression analysis and the significant causal variables affecting air traffic in each market segment are identified. The application of the models to forecasting future demand is demonstrated. ESA

N91-11721# Aerospatiale, Suresnes (France).
THE EVOLUTION OF REGIONAL AIR TRAFFIC
Danielle Kahan *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 111-11 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

N91-11722# Airport Authority, Munich (Germany, F.R.).
REGIONAL AIR TRAFFIC INTO INTERNATIONAL AIRPORTS: THE DEVELOPMENT IN REGIONAL AIR TRAFFIC
P. Trautmann and C. Parau *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 117-12 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

N91-11723# Eurocontrol Agency, Brussels (Belgium).
AIR TRAFFIC CONTROL ASPECTS FOR THE TIME BEYOND 1992
Hansjuergen vonVilliez *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 121-12 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.For land transportation vehicles see *85 Urban Technology and Transportation.*

N91-11746 Georgia Inst. of Tech., Atlanta.
A METHOD OF COMPUTING THE AERODYNAMIC INTERACTIONS OF A ROTOR-FUSELAGE CONFIGURATION IN FORWARD FLIGHT Ph.D. Thesis
John Donaldson Berry 1990 184 p
Avail: Univ. Microfilms Order No. DA9031257

A method is derived for determining the combined aerodynamic effects of a lifting rotor system in the presence of a non-lifting fuselage. The method allows for the full aerodynamic interaction of the lifting rotor blades, the non-lifting body, and the wake sheets trailing from the rotor blades. The wake sheets are allowed to convect with the local induced velocities, creating a distorted wake geometry. The method models the fluid viscous effects by confining these effects to regions adjacent to the bodies and to the wake sheet. The flow outside these regions is modelled as an incompressible potential. A vortex lattice system consisting of discrete vortex filaments is used to represent the lifting rotor system and rotor wake. The non-lifting fuselage is modelled with constant strength source panels. The method develops the trailing wake system by time marching from an initial impulsive start. Azimuthal

dependent velocities and pressures are predicted. The predictions are compared with other analysis and experimental data.
Dissert. Abstr.

N91-11747# Technische Univ., Berlin (Germany, F.R.). Sonderfurschungsbereich 203.
A MODULUS FOR FLIGHT SIMULATION IN A COMPUTER AIDED PROJECT OF COMMERCIAL AIRPLANES [EIN MODULE ZUR FLUGSIMULATION IM RECHNERUNTERSTUETZTEN ENTWURF VON VERKEHRESFLUGZEUGEN]
P. Matsiridis Feb. 1990 84 p In GERMAN
(ILR-Mitt-235(1990); ETN-90-97908) Avail: NTIS HC/MF A05

A high capacity Computer Aided Design (CAD) system for an aircraft preliminary design was developed. During the research work, it appeared necessary to increase the analysis accuracy of the concept project through a simulation modulus. The modulus for flight simulation is presented. The motivation for its acceptance in the system is explained. The motion equations are determined and the moments and forces working on the aircraft are calculated. The problematics of the critical values of the system variables is explained, using the flight mechanical model built in this connection. The results of the representative simulation tasks are indicated.
ESA

N91-11748# Naval Postgraduate School, Monterey, CA.
APPLICATION OF H INFINITY METHOD TO MODERN FIGHTER CONFIGURATION M.S. Thesis
Ta-Chieh Hsu Dec. 1989 88 p
(AD-A225400) Avail: NTIS HC/MF A05 CSCL 01/1

H-Infinity optimal control theory, based on singular value loop shaping, is used to synthesize a controller for the statically unstable longitudinal dynamics of X-29 aircraft. Two design cases are studied: 2-input 2-output; and 3-input 3-output cases. H-Infinity theory provides a direct, effective procedure for synthesizing control laws satisfying specified performance objectives and robustness specifications. The 2 I/O case has better performance, a better response and is more robust, than 3 I/O case.
GRA

N91-11749# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
EFA DEVELOPMENT: KEY TECHNOLOGY AND DESIGN FEATURES Status Report
Peter Weger 1990 33 p Presented at 22nd European Symposium, Arles, France, 30 May - 1 Jun. 1990
(MBB/FE44/S/PUB/0402; ETN-90-98149) Avail: NTIS HC/MF A03

The development status of EFA (European Fighter Aircraft) aerodynamics, structure and engine is discussed. The delta-canard design, moving foreplane, flight control system, sealed slats, two shock chin intake with varicowl and flight control characteristics are described. The weight of the aircraft is investigated. Excess thrust is addressed. The EFA airplane will be powered by two turbofan engines. New technological features are outlined. The development schedule, flight test principles and trials philosophy are described.
ESA

N91-11714# Aerospatiale, Toulouse (France). Aircraft Div.
ATR 72: THE FIRST CIVIL AIRCRAFT WITH A CARBON FIBRE REINFORCED PLASTIC WING
B. Medda *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 47-51 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

N91-11726# Groupement d'Interest Economique, Cergy-Saint Christophe (France).
NEW TECHNOLOGIES AND CUSTOMER ACCEPTANCE
E. Pavard *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 133-13 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

N91-11728# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (Germany, F.R.). Fatigue and Fracture Mechanics Dept.
FULL SCALE FATIGUE AND DAMAGE TOLERANCE TESTING OF MODERN TRANSPORT AIRCRAFT
H.-J. Schmidt and B. Brandecker *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 147-15 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

N91-11768# Technische Univ., Delft (Netherlands).
OPTIMAL INPUTS FOR AIRCRAFT PARAMETER ESTIMATION
J. A. Mulder *In its* Essays on Stability and Control Oct. 1989 36 p (For primary document see N91-11759 03-09)
Avail: NTIS HC/MF A12

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N91-11750 Kansas State Univ., Manhattan.
INTEGRATION OF TIME-VARYING DATA INTO KNOWLEDGE-BASED SYSTEMS FOR AVIONICS APPLICATIONS Ph.D. Thesis
David Scott Hardin 1989 93 p
Avail: Univ. Microfilms Order No. DA9016521

Any knowledge-based system that is to be placed in the cockpit must deal with a wealth of time-varying data, and do so in real time. An avionics knowledge-based system thus requires a conventional signal processing front end to identify relevant signal characteristics, a knowledge representation scheme that lends itself naturally to the representation of uncertain numeric data, and an efficient, interruptible inferencing method. A hardware architecture for knowledge-based avionics systems is proposed which consists of a signal processor and one or more symbol processors. The blackboard paradigm is proposed as the basis for the software architecture. Dempster-Shafer theory is used to express uncertain numerical data. It is shown that the Dempster-Shafer formalism and the four-valued logic of Belnap are complementary, allowing numeric and non-numeric expressions of uncertainty to co-exist. It is also demonstrated that the Kalman filter, a common software component of avionics systems, can be used to provide uncertainty information about numeric data to a Dempster-Shafer evidential reasoning system. An initial software implementation developed in the Ada programming language is discussed.
Dissert. Abstr.

N91-11715# British Aerospace Public Ltd. Co., Woodford (England).
THE CERTIFICATION OF THE AVIONIC SYSTEMS ON THE ATP TO JAR 25
J. A. Shimmin *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 53-61 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

N91-11729# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Bonn (Germany, F.R.).
DIGITAL GLASS COCKPIT FOR COMMUTER AIRCRAFT
Horst Kister *In its* European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 157-168 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

N91-11761# Technische Univ., Delft (Netherlands).
INSTRUMENTATION REQUIREMENTS AND PRESAMPLE FILTER DESIGN FOR MEASUREMENTS DURING NON STEADY MANEUVERS WITH THE HAWKER HUNTER MK 7, PH-NLH
K. vanWoerkom *In its* Essays on Stability and Control Oct. 1989 15 p (For primary document see N91-11759 03-09)
Avail: NTIS HC/MF A12

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N91-11751 George Washington Univ., Washington, DC.
EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF LOW-SOLIDITY AXIAL TURBINES Ph.D. Thesis
Jamshid Zakizadeh Irdmusa 1990 173 p
Avail: Univ. Microfilms Order No. DA9017235

The blade leading edges of a small low-solidity axial turbine were redesigned to obtain operational flexibility. Further flexibility was gained by using a low-solidity cascade, which allowed the leading edges to have a higher radius of curvature. The cascade also allowed larger flow deflections, which resulted in higher utilization factors. Because of the smaller frictional surfaces associated with the low-solidity cascade, the losses were minimized and higher performance achieved. Two small low-solidity axial turbines, one with a high profile ratio and the other with a low profile ratio, were tested. Their performances were evaluated by the temperature drop across them and also by measuring their power output in a specially designed test rig. The velocity fields at the exit of both turbines were mapped out by a one-component laser Doppler velocimeter. The internal flow in the nozzles was visualized by water flow simulation with dye injection. The internal fluid dynamics were simulated by computer. The inviscid flow computer programs MERIDL and TSONIC were used to predict the flow field in both turbines. The location of stagnation points at the leading edge, streamline patterns, pressure distributions, and loading coefficients were determined. Observed streamline patterns were found to agree with predicted ones. Findings show that the turbine with conventional leading edges (low profile ratio) was very susceptible to changes in the operating condition, while the turbine with newly designed blades (high profile ratio) had very high operational flexibility, complemented by high performance for a wide range of speeds. Findings also show that high performance can be achieved with low-solidity cascades without being penalized for the losses due to flow separation. Dissert. Abstr.

N91-11752*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AN UPDATE OF ENGINE SYSTEM RESEARCH AT THE ARMY PROPULSION DIRECTORATE
George A. Bobula Nov. 1990 18 p Presented at the Rotary Wing Propulsion Specialists' Meeting, Williamsburg, VA, 13-15 Nov. 1990; sponsored in part by the American Helicopter Society, Inc. Prepared in cooperation with Army Aviation Systems Command, Cleveland, OH
(DA Proj. 1L1-62211-A-47-A)
(NASA-TM-103278; E-5726; NAS 1.15:103278; AVSCOM-TR-90-C-021) Avail: NTIS HC/MF A03 CSCL 21E

The Small Turboshaft Engine Research (STER) program provides a vehicle for evaluating the application of emerging technologies to Army turboshaft engine systems and to investigate related phenomena. Capitalizing on the resources at hand, in the form of both the NASA facilities and the Army personnel, the program goal of developing a physical understanding of engine system dynamics and/or system interactions is being realized. STER entries investigate concepts and components developed both in-house and out-of-house. Emphasis is placed upon evaluations which have evolved from on-going basic research and advanced development programs. Army aviation program managers are also encouraged to make use of STER resources, both people and facilities. The STER personnel have established their reputations as experts in the fields of engine system experimental evaluations and engine system related phenomena. The STER facility has demonstrated its utility in both research and development programs. The STER program provides the Army aviation community the opportunity to perform system level investigations, and then to offer the findings to the entire engine community for their consideration in next generation propulsion systems. In this way results of the fundamental research being conducted to meet small turboshaft engine technology challenges expeditiously find their way into that next generation of propulsion systems. Author

N91-11753*# Sverdrup Technology, Inc., Brook Park, OH.
NUMERICAL STUDY OF SUPERSONIC COMBUSTORS BY MULTI-BLOCK GRIDS WITH MISMATCHED INTERFACES Final Report
Young J. Moon Oct. 1990 14 p Presented at the 2nd National Aerospace Planes Conference, Orlando, FL, 29-31 Oct. 1990; sponsored in part by AIAA
(Contract NAS3-25266)
(NASA-CR-185306; E-5818; NAS 1.26:185306; AIAA-90-5204)
Avail: NTIS HC/MF A03 CSCL 21E

A three dimensional, finite rate chemistry, Navier-Stokes code was extended to a multi-block code with mismatched interface for practical calculations of supersonic combustors. To ensure global conservation, a conservative algorithm was used for the treatment of mismatched interfaces. The extended code was checked against one test case, i.e., a generic supersonic combustor with transverse fuel injection, examining solution accuracy, convergence, and local mass flux error. After testing, the code was used to simulate the chemically reacting flow fields in a scramjet combustor with parallel fuel injectors (unswept and swept ramps). Computational results were compared with experimental shadowgraph and pressure measurements. Fuel-air mixing characteristics of the unswept and swept ramps were compared and investigated. Author

N91-11754 California Univ., Berkeley.
RAMJET COMBUSTION INSTABILITIES: AN ANALYTICAL AND NUMERICAL MODEL Ph.D. Thesis
Luc Bauwens 1989 109 p
Avail: Univ. Microfilms Order No. DA9028735

A stability analysis of a ramjet combustor is presented. The analysis focuses on a situation for which experimental data are available. The Mach number is low, pressure oscillations are large, and frequencies are lower than acoustics. The flame oscillates and goes through the exhaust nozzle during part of each cycle. The data are consistent with a slow modulation of the total mass of mixture in the system. This bulk oscillation interferes with entropy modes of oscillation and may destabilize them. A multiple time scale analysis is developed. It decouples to some extent the fast mechanisms: acoustics and flame motion, from the slow bulk/entropy mode. Both problems, fast and slow are then analyzed. The flame motion forces inlet duct acoustics. A numerical simulation of the flame motion shows that for typical combustor dimensions, the flame will eventually reach the exhaust nozzle, thus not only forcing inlet acoustics, but also creating conditions for the bulk instability. However, assuming the slow problem to remain stable, once the flame reaches the nozzle, its motion approaches a stable, stationary pattern. This validates the assumption that the long time scale, bulk oscillation is the instability mechanism. Results of a stability analysis for the slow problem show the bulk/entropy mode to be unstable if the burning rate decreases at a sufficiently strong rate when the velocity at the inlet to the combustor increases. Dissert. Abstr.

N91-11755 California Univ., Berkeley.
LOW-FREQUENCY PRESSURE OSCILLATIONS IN A MODEL RAMJET DUMP COMBUSTOR Ph.D. Thesis
Kenneth Hyupsang Yu 1989 138 p
Avail: Univ. Microfilms Order No. DA9029081

An experimental investigation was undertaken to understand the nature of low frequency, high amplitude pressure oscillations that occur in ramjet dump combustors. These oscillations often cause significant practical problems (excessive vibration, excessive heat transfer, and inlet unstart). A two dimensional, variable geometry, dump combustor model was used. To determine the sources of pressure disturbances in the flow field, a cold flow

study, utilizing a hot film, was carried out. A reacting flow study included pressure, velocity, and radiation measurements as well as flow visualizations which employed a phase sensitive schlieren technique. Pressure and velocity measurements were made at various locations in the inlet duct and combustor to determine the pressure and velocity field during an unstable operation. Global C2 and CH radical emission intensities were measured to determine the phase relation between heat release rate and pressure in the combustor. The phase sensitive schlieren technique allowed tracking of the flame front during the entire pressure cycle. Holding the equivalence ratio fixed, the combustor geometry and inlet velocity were varied under two different inlet configurations. The parametric variations were used to study the effect of mean fluid residence time on frequency of the oscillation. The experimental results interpreted with the aid of acoustic and residence time analyses show that the low frequency instability does not always occur at the acoustic resonance frequencies. The frequency appears to be controlled by both the acoustics in the inlet duct and the fluid convection inside the combustor. Specifically, the instability period appears to be the sum of the fluid convection time inside the combustor and the corresponding feedback time from the inlet acoustic resonance characteristic. The sustenance of the oscillations during instability seems to be the result of oscillating heat release which occurs at the proper phase which satisfies Rayleigh's criterion. Dissert. Abstr.

N91-11756# Universal Technology Corp., Dayton, OH.
GROUND ENVIRONMENT CHARACTERIZATION OF STOVL FIGHTER PROPULSION SYSTEMS Final Report, Nov. 1988 - Nov. 1989
Randolph W. Spratt Aug. 1990 89 p
(Contract F33615-88-C-2823; AF Proj. 3066)
(AD-A225372; WRDC-TR-90-2058) Avail: NTIS HC/MF A05
CSCL 01/3

The report contains information on the ground environment produced by STOVL propulsion systems. Data on impingement flow fields, heat transfer rates of impinging jets, and STOVL fighter exhaust characteristics are included. An analysis method was developed by UTC to estimate STOVL ground environments. Ground environments were estimated for the AV-8, Remote Augmented Lift (RAL), Remote Exhaust (REX), Hybrid Fan Vectored Thrust (HFVT), ejector augmentor, and lift plus lift/cruise propulsion systems. The effect of these ground environments on aluminum plates, asphalt concrete, Portland Cement Concrete (PCC), and steel plates was estimated. Facilities capable of conducting ground environment test were identified. GRA

N91-11757# Air Force Materials Lab., Wright-Patterson AFB, OH. Materials Integrity Branch.
PROCEEDINGS OF THE 1989 STRUCTURAL INTEGRITY PROGRAM CONFERENCE Final Report
Thomas D. Cooper, ed. and John W. Lincoln, ed. (Aeronautical Systems Div., Wright-Patterson AFB, OH.) Apr. 1990 1033 p Conference held in San Antonio, TX, 5-7 Dec. 1989 LIMITED REPRODUCIBILITY: Availability: Document partially illegible
(AD-A225541; WRDC-TR-90-4051) Avail: NTIS HC/MF A99
CSCL 01/3

The purpose of this conference was to bring together technical personnel in DOD and the aerospace industry involved in the various turbine engines, airframes and other mechanical systems. It provided a forum to exchange ideas relating to the critical aspects of durability and damage tolerance technology for aircraft systems. Session topics included structural analysis; structural analysis and testing; materials and nondestructive evaluation; aircraft engine structural integrity; and force management. GRA

N91-11758# Wright Research Development Center, Wright-Patterson AFB, OH. Technology Branch.
STAGE EFFECTS ON STALLING AND RECOVERY OF A HIGH-SPEED 10-STAGE AXIAL-FLOW COMPRESSOR Final Report, 1 Feb. 1987 - 1 Jan. 1989
William W. Copenhaver Jun. 1990 401 p
(AF Proj. 3066)
(AD-A225662; WRDC-TR-90-2054) Avail: NTIS HC/MF A18
CSCL 13/7

Results of a High-speed 10-stage axial-flow compressor test involving overall compressor and individual stage performance while stalling and operating in quasi-steady rotating stall are described. Test procedures and data acquisition methods used to obtain the dynamic stalling and quasi-steady in-stall data are explained. Unstalled and in-stall data obtained from the compressor operating at five different shaft speeds and one off-schedule variable vane condition are presented. The effects of compressor speed and variable geometry on overall compressor in-stall pressure rise and hysteresis extent are illustrated through the use of quasi-steady stage temperature and pressure rise characteristics. The results indicate that individual stage performance during overall compressor. Time resolved install data acquired at two different shaft speeds are presented in support of the notion that stage operation varies significantly from entrance to exit of the compressor. Both time-averaged and time-resolved individual stage results suggest that stage matching is important, not only for unstalled performance but also for in-stall performance and recoverability from stall. The measured high-speed 10-stage test compressor individual stage pressure and temperature characteristics were input into a stage-by-stage dynamic compressor performance model. The analytical model had been previously validated for the prediction of low-speed compressor stalling and in-stall performance. GRA

N91-11725# Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany, F.R.).
ENGINE MAINTAINABILITY: OBJECTIVES AND METHODS
A. Senft *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 129-13 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

N91-11730# Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany, F.R.).
PROPFAN TECHNOLOGY
M. Dupslaff, P. Wehlitz, and P. Schimming *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 169-17 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

N91-11731# Rolls-Royce Ltd., Derby (England).
THE PLACE FOR THE TURBOFAN ENGINE IN THE REGIONAL AIRLINES
P. Simpkin *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 173-17 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

N91-11732# Aerospatiale, Toulouse (France).
CHOICE OF PROPULSION FOR NEXT GENERATION AIRCRAFT
Robert Hinsinger *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 181-18 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

N91-11733# Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany, F.R.).
REQUIREMENTS FOR TURBOPROP AND TURBOFAN ENGINES IN REGIONAL AIRCRAFT
H. E. Groenewald and E. Wuerzinger *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 189-19 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

N91-11734# Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany, F.R.).
PW300: POWERPLANT FOR REGIONAL AIRCRAFT
R. Hill *In* DGLR, European Forum: The Evolution of Regional

Aircraft Technologies and Certification 1989 p 195-19 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

No abstracts in this category.

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N91-11759# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
ESSAYS ON STABILITY AND CONTROL
M. Baarspul, ed. and J. A. Mulder, ed. Oct. 1989 252 p (LR-600; ETN-90-97166) Avail: NTIS HC/MF A12

The role of the human pilot in flight management and control was considered through mathematical models of pilot behavior, the role of the engineering pilot in flight deck development, and the visual-vestibular interaction in pilot's perception of aircraft or simulator motion. Instrumentation requirements and presample filter design for measurements during unsteady maneuver is discussed. Simulation techniques, and the specifying, buying and accepting of a flight simulators are examined. Semi passive attitude stabilization concepts for geodetic satellite are studied. Mathematical models for parameter estimation for stochastic systems, optimal inputs for aircraft parameter estimation, and flight in turbulence and wind shear are given. For individual titles, see N91-11760 through N91-11769.

N91-11760# Technische Univ., Delft (Netherlands).
DEVELOPMENTS IN MATHEMATICAL MODELS OF HUMAN PILOT BEHAVIOR **c53**
O. H. Gerlach *In its* Essays on Stability and Control Oct. 1989 27 p (For primary document see N91-11759 03-09)
Avail: NTIS HC/MF A12

Attention is paid to the physiological and psychological parts of the pilot's task, the processing of sensed data and decision making. Two engineering pilot models which are used on a wide scale, the cross-over model and the optimal control model are presented. A biomorphic model is discussed with the aim of describing how the data handling and decision making processes going on in the pilot's brain may be modeled mathematically along with the control process proper on which existing models concentrate. This model aims at obtaining a closer and more detailed mathematical description of what actually goes on in the living organism. The use of models in the evaluation of aircraft handling qualities is addressed. ESA

N91-11761# Technische Univ., Delft (Netherlands).
INSTRUMENTATION REQUIREMENTS AND PRESAMPLE FILTER DESIGN FOR MEASUREMENTS DURING NON STEADY MANEUVERS WITH THE HAWKER HUNTER MK 7, PH-NLH **c06**
K. vanWoerkom *In its* Essays on Stability and Control Oct. 1989 15 p (For primary document see N91-11759 03-09)
Avail: NTIS HC/MF A12

The requirements for the instrumentation for the Hunter measurements are described with emphasis on the design of the presample filters. The applied data collection described has a sample rate of 400 measurements per second and an overall accuracy of 0.02 percent. The transducers used have different accuracies depending on the type and application, from 0.01 to 5 percent. To monitor the accuracy during the flight test period, rather extensive calibrations were carried out before, between and after the actual measurement flights. Diagrams are given including the architecture of the instrumentation system, and the accompanying ground equipment. Formal requirements for flight test instrumentation systems are discussed, and the method used for the design of the required electronic filters is described. ESA

N91-11762# Royal Dutch Airlines, Schiphol (Netherlands).
SPECIFYING, BUYING AND ACCEPTING A FLIGHT SIMULATOR
J. M. vanSliedrecht, M. L. Wijnheijmer, and R. P. A. M. Teunissen *In* Tech. Univ. Delft, Essays on Stability and Control Oct. 1989 11 p (For primary document see N91-11759 03-09)
Avail: NTIS HC/MF A12

The process of specifying, buying and accepting a flight simulator by an airline is described. Special emphasis is put on the acceptance of the simulator and the specific role of the engineering pilot. Some examples of the contributions of the engineering pilot to the quality of the flight simulator are given. To conclude, some remarks on the task of the engineering pilot in a flight simulator project are made. ESA

N91-11763# National Aerospace Lab., Amsterdam (Netherlands).
PHASE 2 FLIGHT SIMULATOR MATHEMATICAL MODEL AND DATA-PACKAGE, BASED ON FLIGHT TEST AND SIMULATION TECHNIQUES
A. M. H. Nieuwpoort, J. H. Breeman, M. Baarspul, and J. A. Mulder (Technische Univ., Delft, Netherlands) *In its* Essays on Stability and Control Oct. 1989 18 p Previously announced in IAA as A89-13633 (For primary document see N91-11759 03-09)
Avail: NTIS HC/MF A12

A flight simulator for ground training of Cessna Citation 500 aircraft is addressed. In order to acquire the necessary information in the relatively short period of time available for the execution of the flight tests and the analysis, use was made intensively of dynamic flight test techniques in relation with computer data processing. The mathematical models to be identified must give an adequate description of the aerodynamic forces and moments, the engine characteristics, the flight control system and the landing gear characteristics. In order to evaluate and test the general models, both offline and online (pilot in the loop) simulations were performed on the computer and moving base flight simulator. Comparisons were made between the measured flight test time histories and the computed model responses. The employed instrumentation system, the flight test program, the data processing and corresponding parameter identification and the synthesis of the various models, are presented. ESA

N91-11764# Royal Dutch Airlines, Amsterdam (Netherlands).
FLIGHT DECK DEVELOPMENT AND THE ENGINEERING PILOT
H. Benedictus *In* Tech. Univ. Delft, Essays on Stability and Control Oct. 1989 27 p (For primary document see N91-11759 03-09)
Avail: NTIS HC/MF A12

Background information on the procedures followed when a new flight deck has to be developed is presented. The Boeing 747-400 is used as a typical example. Dealings between the manufacturer and the airline company are outlined. The airline input is useful to achieve a safe, economic and user friendly product. Only a fraction of the discussions are covered. These include: the integrated display system; EFIS and ELCAS features; caution and warning features; navigation; and autoflight. ESA

N91-11765# Technische Univ., Delft (Netherlands).
SEMI PASSIVE ATTITUDE STABILIZATION FOR A GEODETIC SATELLITE **c18**
P. P. vandenBroek *In its* Essays on Stability and Control Oct. 1989 22 p (For primary document see N91-11759 03-09)
Avail: NTIS HC/MF A12

A stabilization concept for a geodetic satellite is described. In view of the pointing requirements passive gravity gradient stabilization could be applied. For thermal control, it would be useful to rotate the satellite about its vertical axis. It is proposed to eliminate the resulting gyroscopic cross coupling effect by employing a counter rotating flywheel. The system, some of the critical aspects and the reliability of the total system, are described. ESA

N91-11766# Technische Univ., Delft (Netherlands).
VISUAL-VESTIBULAR INTERACTION IN PILOT'S PERCEPTION OF AIRCRAFT OR SIMULATOR MOTION **c53**
R. J. A. W. Hosman and J. C. vanderVaart *In its* Essays on Stability and Control Oct. 1989 24 p (For primary document see N91-11759 03-09)
Avail: NTIS HC/MF A12

The importance of man's vestibular organs in perceiving cockpit motion in an aircraft or a simulator is nowadays hardly questioned, as witnessed by the present widespread use of six degrees of freedom motion systems for flight simulators. Still more advantages could be gained from the use of moving base simulators. To illustrate this, research on control behavior and performance of subjects in target following and disturbance tasks is reviewed. By using results of work by the authors and by others, the importance of peripheral visual and vestibular motion perception in tasks that require inner-loop stabilization, is emphasized. Results of stimulus response experiments, especially designed to gather insight in central and peripheral visual and vestibular perception of motion are summarized and used to explain findings of tracking experiments. It is concluded that peripheral visual and cockpit motion cues are of paramount importance in actual or simulated manual aircraft control and that, in simulation, the compensation for simulator motion system dynamics, computing time delays and motion control laws deserve much more attention. ESA

N91-11767# Royal Dutch Airlines, Amsterdam (Netherlands).
PARAMETER ESTIMATION FOR STOCHASTIC SYSTEMS **c61**
P. J. G. Loos *In* Tech. Univ. Delft, Essays on Stability and Control Oct. 1989 26 p (For primary document see N91-11759 03-09)
Avail: NTIS HC/MF A12

A parameter estimation program for stochastic systems (MLPEFSS) is reviewed. The program employs a Gauss-Newton optimization of a maximum likehood criterion to estimate the unknown parameters appearing in a linear, time invariant state space description of a stochastic system. The state space description for dynamic systems and the definition of statistical estimators are discussed. The filter-error method is presented in a form well suited for computer implementation. This method combines a nonstationary Kalman filter with an output-error parameter estimation technique thus accounting for both process noise (unmeasured stochastic input signals) and measurement noise. The problem of optimizing the nonlinear likehood function resulting from the filter-error method with respect to the unknown parameters is discussed. The Hooke and Jeeve direct search method and the second order Gauss-Newton optimization algorithm are treated in more detail. The results of one of the test cases which were used to validate the Maximum Likehood Parameter Estimation program For Stochastic Systems (MLPEFSS) are given. ESA

N91-11768# Technische Univ., Delft (Netherlands).
OPTIMAL INPUTS FOR AIRCRAFT PARAMETER ESTIMATION **c05**
J. A. Mulder *In its* Essays on Stability and Control Oct. 1989 36 p (For primary document see N91-11759 03-09)
Avail: NTIS HC/MF A12

The accuracy of aircraft stability and control derivatives as estimated from dynamic response measurements depends on the form of the time histories of the control inputs. After selecting a suitable criterion and imposing constraints on either the aircraft's state or the control inputs it is possible to optimize the form of these time histories. A method for control input optimization is proposed which avoids some disadvantages of earlier methods and was successfully applied in the design of longitudinal and lateral flight test maneuvers. ESA

N91-11769# Technische Univ., Delft (Netherlands).
MATHEMATICAL MODELLING OF FLIGHT IN TURBULENCE AND WINDSHEAR **c47**
M. Baarspul *In its* Essays on Stability and Control Oct. 1989 37 p (For primary document see N91-11759 03-09)
Avail: NTIS HC/MF A12

A method to generate 'patchy' atmospheric turbulence and windshear for pilot-in-the-loop, realtime flight simulation is described. The turbulence model generates five uncorrelated, nonGaussian turbulence velocities, which disturb the forces and moments in the equations of motion of the airplane. The wind speed and direction, for the realtime simulation of windshear, are modeled by expressions matched to experimental data. Some examples of thunderstorm shears and microbursts are presented. ESA

N91-11770*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A UNIQUE HIGH HEAT FLUX FACILITY FOR TESTING HYPERSONIC ENGINE COMPONENTS
Matthew E. Melis and Herbert J. Gladden 1990 10 p Presented at the 2nd International Aerospace Planes Conference, Orlando, FL, 29-31 Oct. 1990; cosponsored by AIAA, and NASP
(NASA-TM-103238; E-5657; NAS 1.15:103238) Avail: NTIS HC/MF A02 CSCL 14B

A major concern in advancing the state-of-the-art technologies for hypersonic vehicles is the development of an aeropropulsion system capable of withstanding high thermal loads expected during hypersonic flights. Consequently, there is a need for experimental facilities capable of providing a high heat flux environment for testing compound concepts and verifying analyses. A hydrogen/oxygen rocket engine was developed to provide a high enthalpy/high heat flux environment for component evaluation. This Hot Gas Facility is capable of providing heat fluxes ranging from 200 (on flat surfaces) up to 8000 Btu per sq ft per sec (at a leading edge stagnation point). Gas temperatures up to 5500 R can be attained as well as Reynolds numbers up to 360,000 per ft. Test articles such as cowl leading edges, transpiration-cooled seals, fuel injectors, and cooled panel concepts can be evaluated with gaseous hydrogen as coolant. This facility and its configuration and test capabilities are discussed. Results from flow characterization experiments are also shown and their implications considered. Author

N91-11771# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Structures and Materials Panel, Working Group 22.
AIRCRAFT OPERATIONS ON REPAIRED RUNWAYS
Duncan J. Eckford, ed. Aug. 1990 119 p
(AGARD-R-731; ISBN-92-835-0574-3) Copyright Avail: NTIS HC/MF A06; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The results of an AGARD Working Group, (WG.22) directed by the Structures and Materials Panel are presented. The Working Group was tasked to develop design requirements and qualification methods the application of which, across NATO, would improve aircraft utilization and interoperability. The subject of repaired-runway operation is developed and illustrated; its sections reflect the various aims of the Working Group while the appendices amplify particular aspects. Throughout, topics are discussed from fundamentals so that it may provide an introduction to the structural and dynamical implications of repaired-runway operation as well

as a statement of the current level of development of techniques in design, assessment, and operational clearance. Author

N91-11772# Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
CONDITION SURVEY AND PAVER IMPLEMENTATION, EDWARDS AIR FORCE BASE (NORTH BASE), CALIFORNIA Final Report
Ross A. Bentsen Jun. 1990 37 p
(Contract F04611-89-X-0091)
(AD-A224978; WES/MP/GL-90-7) Avail: NTIS HC/MF A03 CSCL 01/5

A pavement condition survey was performed on the North Base airfield at Edwards Air Force Base, California, in August 1989 for the purpose of determining the pavement condition index of the airfield features and for performing the initial implementation of the PAVER pavement management system. The pavement identification and condition survey data were input into a Micro Paver data base. GRA

N91-11773# Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
CONDITION SURVEY AND PAVER IMPLEMENTATION, EDWARDS AIR FORCE BASE, CALIFORNIA Final Report
Ross A. Bensten Jun. 1990 71 p
(Contract F04611-89-X-0091)
(AD-A224979; WES/MP/GL-90-9) Avail: NTIS HC/MF A04 CSCL 05/1

A pavement condition survey was performed at Edwards Air Force Base, California, in August 1989 for the purpose of determining the pavement condition index of the airfield features and for performing the initial implementation of the PAVER pavement management system. The pavement identification and condition survey data were input into a Micro PAVER data base. GRA

N91-11774# IIT Research Inst., Lanham, MD.
OBJECT-ORIENTED SOFTWARE REQUIREMENTS SPECIFICATION FOR THE UH-1 HELICOPTER FLIGHT SIMULATOR
Katherine S. Miller, Donald L. Ross, Donna E. Grimes, and Marilyn J. Marcelli 28 Jun. 1990 157 p
(Contract MDA903-87-D-0056)
(AD-A225041) Avail: NTIS HC/MF A08 CSCL 01/2

The purpose of this document is to explore object-oriented requirements analysis. The document is divided into three sections. The first section is a theoretical overview of object-oriented requirements analysis. It attempts to define what object-oriented requirements analysis is and to justify its use. The second section details the approach adopted for identifying and formulating the requirements listed in this document. The third section contains a case study, in which the approach described in the preceding section is applied. GRA

N91-11775# Pailen-Johnson Associates, Inc., Vienna, VA.
CRITERIA FOR THE USE OF LIME-CEMENT-FLYASH ON AIRPORT PAVEMENTS Final Report
William Pailen Dec. 1989 132 p
(Contract DTFA01-85-C-01047)
(AD-A225226; DOT/FAA/DS-89/36) Avail: NTIS HC/MF A07 CSCL 01/5

A laboratory Lime Cement Flyash (LCF) assessment program was conducted in which samples were fabricated using LCF materials from Ohio, Pennsylvania, Oregon, and Texas sources. The samples were analyzed for the effects of LCF ingredient variations on modulus of resilience, unconfined compressive strength, fracture toughness, tensile strength, and fatigue. Effects of deicing chemicals on modulus of resilience, unconfined compressive strength, fracture toughness, and tensile strength were analyzed. A field testing program was conducted in which core samples were obtained from Newark, Portland, and JFK airports. The samples were tested for modulus of resilience and unconfined compressive strength. A search was conducted of pertinent recent literature on pavement design and analysis, especially LCF pavements. GRA

N91-11776# Naval Civil Engineering Lab., Port Hueneme, CA.
RAPID RUNWAY REPAIR (RRR) TECHNIQUES: A SYSTEMS ANALYSIS Final Report, Jun. 1987 - Jan. 1990
Shujie Chang May 1990 66 p
(AD-A225238; NCEL-TN-1813) Avail: NTIS HC/MF A04 CSCL 01/5

An evaluation of nine rapid runway repair (RRR) techniques was performed using the systems analysis approach. This analysis was based on a logical step-by-step procedure of examining the smallest details of each RRR system. The primary objective was to evaluate the RRR systems against criteria (evaluation factors) that were identified to be important in RRR. These criteria included repair time, cost, complexity, etc. The final results showed that the best RRR systems are asphalt blocks, fiberglass reinforced plastic (FRP) mats, and FRP foldable mats. These repair techniques possess the desirable advantages in a RRR system. They are fast, simple, and cost effective, and extensive training is not required. This analysis is not intended to make the decision of which RRR system to implement; it is merely a tool to clearly state the procedures, factors, and rationale that are used to make a decision. GRA

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

No abstracts in this category.

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N91-11777# Colorado Univ., Boulder. Dept. of Telecommunications.
GEOSTATIONARY ORBITAL CROWDING: AN ANALYSIS OF PROBLEMS AND SOLUTIONS M.S. Thesis
Robert Murrell Wilkison, Jr. 1990 249 p Sponsored by AFIT, Wright-Patterson AFB, OH
(AD-A224581; AD-E501254; AFIT/CI/CIA-90-055) Avail: NTIS HC/MF A11 CSCL 22/3

Geostationary orbital crowding is currently a pressing international issue. The disagreement lies between undeveloped and developed nations as to whether geostationary equity or efficiency should be the emphasis of international orbital slot and frequency allocations. The primary desire of less developed nations is an assurance that fundamental satellite resources will be available when they are ready. This can only be realized if the international community sets aside resources for their exclusive use, to be usable later. The developed countries feel that such a plan would result in an inefficient utilization of orbital resources. They also believe that by the time these undeveloped nations are able to launch communications satellites, technology will have made added resources available for their use. The best possible plan will be one that uses a composite of all practical options. All technical solutions must be incorporated as they become viable, while regulatory alternatives should be implemented as needed, to ensure that every nation has access to space communications resources when their situation dictates. Excess orbital resources may be marketed to further the development of telecommunications in the developing world. Various methods for ensuring both efficient and equitable future access to space communications resources are detailed. GRA

N91-11778# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
AN APPLICATION OF THE A* SEARCH TO TRAJECTORY OPTIMIZATION M.S. Thesis
Craig K. Niiya May 1990 90 p Sponsored by AFIT, Wright-Patterson AFB, OH
(AD-A224677; AFIT/CI/CIA-90-033) Avail: NTIS HC/MF A05 CSCL 22/3

As space operations become more complex and ambitious, there is a corresponding increase in the sophistication required of on-board algorithms for proximity operations. Unmanned missions such as planetary probes require sophisticated algorithms to deal with evolving mission requirements and contingencies, where man-in-the-loop control will be impractical. Other future missions that require autonomy for safety or security reasons will also require intelligent on-board controllers. This effort discusses a structure for a candidate proximity operations controller and provides initial development of an intelligent trajectory planner in three degrees of freedom using the A * Node Search technique. GRA

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N91-11779# Ballistic Research Labs., Aberdeen Proving Ground, MD.
TEST RESULTS FROM A TWO-STAGE TRAVELING CHARGE LIQUID PROPELLANT GUN Final Technical Report, May 1987 - Sep. 1989
Irvin C. Stobie, John D. Knapton, Bruce D. Bensinger, and Robert A. Pate (General Electric Co., Pittsfield, MA.) Jun. 1990 29 p
(AD-A224593; BRL-TR-3112) Avail: NTIS HC/MF A03 CSCL 19/1

Test data for a 40-mm fractional traveling charge (FTC) gun system are described. The system consists of a hybrid propulsion method using a solid propellant booster charge and a liquid propellant traveling charge. The purpose of the two stage propellant system was to create a traveling charge gun with a delay mechanism created by a separator piston between the solid and liquid charges. The data showed increased performance when compared to the Mayer Hart model, for projectiles less than 250 grams and charge to mass (C/M) ratios of less than 2. Tests fired at C/M greater than 2 with heavy projectiles yielded high pressures in the long liquid charges. The combustion of the second stage of the traveling charge produced waves that were tracked in a space time manner for one of the FTC rounds. The calculated wave speed gave reasonable agreement when compared with estimated sound speeds determined from chamber measurements in other regenerative fixtures. GRA

N91-11780# Norwegian Space Center, Oslo.
NORWAY IN SPACE, 1988. A SHORT PRESENTATION OF THE NORWEGIAN SPACE CENTER AND SPACE RELATED INDUSTRY
Oct. 1990 38 p
(NSC-Rept-(89)8; ISBN-82-7542-000-8; ETN-90-98228)
Copyright Avail: NTIS HC/MF A03

The Norwegian Space Center and Andoya rocket range are introduced. Mandatory program involvement includes the Cluster/Solar and Heliospheric Observatory (SOHO) program with particular involvement in cosmic physics and astrophysics. Optional program involvement covers telecommunications, Earth observation, Colombus (ESA space infrastructure program), space transportation (Ariane 5 and Hermes), and microgravity. The Norwegian Industrial Forum for Space Activities is described. Company involvement and capabilities are outlined. ESA

N91-11781# Norwegian Space Center, Oslo.
SPACE RESEARCH IN NORWAY Annual Report, 1988
B. Andersen, Arne Gundersen, and Berit Sorensen Aug. 1989 110 p
(NSC-Rept-(89)5; ISBN-82-7542-001-6; ETN-90-98229) Avail: NTIS HC/MF A06

The main concentration of space science effects in Norway falls within the fields covered by the ESA Solar Terrestrial Science Program. Norwegian scientists are actively participating in six experiments on the Solar and Heliospheric Observatory (SOHO) and Cluster satellites. Space physics, astrophysics, life sciences, space related facilities and ground based observational sites are addressed. ESA

N91-11815# Construcciones Aeronauticas S.A., Madrid (Spain).
COMPACT PAYLOAD TEST RANGE: REFLECTORS DEVELOPMENT
Antonio Jimenez *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 21-25 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N91-11823# Construcciones Aeronauticas S.A., Madrid (Spain). Space Div.
THE DEVELOPMENT OF THE ARIANE-4 ADAPTOR 937B
A. Jimenez, J. Pascual, J. Lechon, and J. Aceituna *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 79-84 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11853# Aerospatiale Aquitaine, Saint-Medard en Jalles (France). Strategic and Space Div.
WOUND HELIUM PRESSURANT TANK DEVELOPMENT FOR 2ND STAGE OF ARIANE 4 LAUNCHER
Y. Valy and P. Coquet *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 267-269 Previously announced in IAA as A90-42134 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

No abstracts in this category.

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N91-11982*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Tracking Systems and Applications Section.
INTERAGENCY TELEMETRY ARRAYING FOR VOYAGER-NEPTUNE ENCOUNTER
D. W. Brown, W. D. Brundage (National Radio Astronomy Observatory, Socorro, NM.), J. S. Ulvestad, S. S. Kent, and K. P. Bartos *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 91-118 (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 09F

N91-11984*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Telecommunications Systems Section.
THE IMPACT OF NRZ DATA ASYMMETRY ON THE PERFORMANCE OF A SPACE TELEMETRY SYSTEM
T. M. Nguyen *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 139-151 (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 09F

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N91-11782*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
SKITTER FOOT DESIGN
Gene Choi, David L. Jones, James Morris, Martin Parham, Jim Stephens, and Gregg Yancey 25 Aug. 1987 105 p
(Grant NGT-21-002-800)
(NASA-CR-184932; NAS 1.26:184932; ME-4182) Avail: NTIS HC/MF A06 CSCL 22B

A mechanical design team was formed to design a foot for the lunar utility vehicle SKITTER. The primary design was constrained to be a ski pole design compatible with the existing femur-tibia design legs. The lunar environment had several important effects on the foot design. Three materials were investigated for the SKITTER foot: aluminum alloys, cold worked stainless steel alloys, and titanium alloys. Thin film coatings were investigated as a method of wear reduction for the foot. The performance of the foot is dependent on the action of the legs. The range of motion for the legs was determined to be vertical to 15 degrees above horizontal. An impact analysis was performed for the foot movement, but the results were determined to be inconclusive due to unknown soil parameters. The initial foot design configuration consisted of an annulus attached to the pointed pole. The annulus was designed to prevent excess sinkage. Later designs call for a conical shaped foot with a disk at the point of the tibia attachment. The conical design was analyzed for strength and deflection by two different approaches. A deformable body analysis was performed for the foot under crane load in crane position, and also under actuator load in the vertical position. In both cases, the deflection of the foot was insignificant and the stresses well below the strength of the titanium alloy. Author

N91-11783*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
PERIODIC-DISTURBANCE ACCOMMODATING CONTROL OF THE SPACE STATION FOR ASYMPTOTIC MOMENTUM MANAGEMENT
Wayne Warren and Bong Wie (Texas Univ., Austin.) 2 Mar. 1989 31 p
(Contract NCC9-16)
(NASA-CR-187264; NAS 1.26:187264) Avail: NTIS HC/MF A03 CSCL 22B

Periodic maneuvering control is developed for asymptotic momentum management of control gyros used as primary actuating devices for the Space Station. The proposed controller utilizes the concepts of quaternion feedback control and periodic-distrubance accommodation to achieve oscillations about the constant torque equilibrium attitude, while minimizing the control effort required. Three-axis coupled equations of motion, written in terms of quaternions, are derived for roll/yaw controller design and stability analysis. It is shown that the quaternion feedback controller is very robust for a wide range of pitch angles. It is also shown that the proposed controller tunes the open-loop unstable vehicle to a stable oscillatory motion which minimizes the control effort needed for steady-state operations. Author

N91-11784 Texas Univ., Austin.
SIMULATION OF AN EXPERIMENT TO MEASURE THE LENSE-THIRRING PRECESSION USING A SECOND LAGEOS SATELLITE Ph.D. Thesis
John Charles Ries 1989 160 p
Avail: Univ. Microfilms Order No. DA9016963

A method for measuring the relative nodal precession of a pair of earth-orbiting satellites, caused by the gravitational dragging of each satellite by the rotating mass of the Earth as predicted by General Relativity was proposed. A new Lageos-type satellite (Lageos-3), which is identical to the Lageos-1 satellite already in orbit, placed in an orbit symmetric about the polar axis with respect to Lageos-1 and tracked with satellite laser ranging may provide the means of eliminating the influence of errors in our knowledge of the longitudinally independent (zonal) part of the Earth's gravitational field. Uncertainties in the knowledge of the even degree zonals for a single satellite mask the predicted precession due to the Lense-Thirring effect, but the use of two satellites in orbits with supplementary inclinations will cause those model errors to cancel. A comprehensive numerical simulation and error analysis is described for the proposed Lageos-3 experiment with the objective of establishing the potential accuracy of the measurement of the Lense-Thirring precession. Consideration was given to identifying the error sources which limit the accuracy of the experiment and proposing procedures for eliminating or reducing the effect of these errors. Dissert. Abstr.

N91-11785*# Bionetics Corp., Hampton, VA.
ADVANCED-TECHNOLOGY SPACE STATION STUDY: SUMMARY OF SYSTEMS AND PACING TECHNOLOGIES Final Report, May 1986 - Oct. 1988
A. J. Butterfield, P. A. Garn, C. B. King, and M. J. Queijo Nov. 1990 141 p
(Contract NAS1-18267)
(NASA-CR-181795; NAS 1.26:181795) Avail: NTIS HC/MF A07 CSCL 22B

The principal system features defined for the Advanced Technology Space Station are summarized and the 21 pacing technologies identified during the course of the study are described. The descriptions of system configurations were extracted from four previous study reports. The technological areas focus on those systems particular to all large spacecraft which generate artificial gravity by rotation. The summary includes a listing of the functions, crew requirements and electrical power demand that led to the studied configuration. The pacing technologies include the benefits of advanced materials, in-orbit assembly requirements, stationkeeping, evaluations of electrical power generation alternates, and life support systems. The descriptions of systems

show the potential for synergies and identifies the beneficial interactions that can result from technological advances. Author

N91-11786 California Univ., Berkeley.
PROBLEMS IN THE CONTROL OF FLEXIBLE SPACECRAFTS Ph.D. Thesis
Omer Morgul 1989 196 p
Avail: Univ. Microfilms Order No. DA9028964

The application of boundary control techniques to a rotating flexible spacecraft is investigated. More precisely, a rigid body, is considered whose center of mass is fixed in an inertial frame with a flexible beam clamped to the rigid body at one end and free at the other end. This configuration is investigated under the assumptions of whether the motion takes place on a plane, or in the three-dimensional space, as well as the model chosen for the beam. In each case, a stabilization problem is posed, a feedback law is proposed, and it is shown that under the proposed control law the stability of the configuration is obtained. Chapter 2 reviews some basic tools of Newtonian Dynamics and some recent developments in the nonlinear beam theories, namely the director theory of beams and the geometrically exact beam theory. Then, as an example, the equations of motion for the configuration mentioned above are derived. Chapter 3 studies the basic configuration under the planar motion assumption and the Euler-Bernoulli beam model is used. Two control laws are proposed, each consisting of a torque applied to the rigid body and a force and a torque applied to the free end of the beam. It is shown that under the proposed control law, exponential stabilization is obtained. Chapter 4 generalizes the results of Chapter 3 to the motion of the same configuration in three dimensions. Chapter 5 proves a stabilization result for the basic configuration using the geometrically exact beam model, without any linearization. Using this result, the results obtained in Chapter 2 are generalized to the case of planar motion of the basic configuration using the Timoshenko beam model. Dissert. Abstr.

N91-11787 Dayton Univ., OH.
OPTIMAL SELECTION OF ORBITAL REPLACEMENT UNIT SPARES: A SPACE STATION SYSTEM AVAILABILITY MODEL Ph.D. Thesis
Douglas Gerard Schwaab 1990 256 p
Avail: Univ. Microfilms Order No. DA9027422

A methodology is investigated for the logistics support analysis of the selection of orbital replacement unit (ORU) on-orbit spares for a space station. A mathematical model is developed to select the ORU spares combination that maximizes system availability and is constrained for both the weight and volume allocated from the pressurized logistics module (PLM) payload capacity for the system's ORU spares. The optimal solution of ORU spares will replenish the space station's on-orbit inventory. The model integrates the system design and logistics parameters to provide a decision support tool for both engineering analysis and logistics resupply planning. The impact of resupply mission scenario, center of gravity, and mechanical vibration restrictions on loading cargo in the PLM are also explored. The analyses consider the deviations from loading the PLM racks with a uniform mass distribution and the resulting loss of usable PLM payload capacity. The system availability model is formulated as a nonlinear integer programming problem and is transformed into a 0 to 1 linear integer programming problem. Conceptual data for the space station's environmental control and life support system (ECLSS) is used to exercise the model and conduct a sensitivity analysis on the model's logistics resupply and system design parameters. A preliminary investigation is conducted on the issue of selecting ORU on-orbit spares when there are multiple systems with different criticality levels. The system availability model solutions are used to approximate the availability response to payload allocations in a prototype, multiple-objective decision model to optimize the distribution of the PLM payload capacity between the multiple systems. To illustrate the methodology, the prototype model is exercised with the subsystems that compose the ECLSS. Dissert. Abstr.

N91-11788# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Dienstleistungsbereich.
NON-LINEAR VIBRATION OF LARGE, IMPERFECT SPACE STRUCTURES
H. Oery, A. Rittweger, E. Hornung, and E. Erben (Erno Raumfahrttechnik G.m.b.H. Bremen, Germany, F.R.) 1990 24 p Presented at International Conference on Dynamics of Flexible Structures in Space, Cranfield, England, 15-19 May 1990 (MBB-UO-0080-90-PUB; ETN-90-97884) Avail: NTIS HC/MF A03

The fundamental dynamic behavior of a large framework structure with imperfect struts is investigated under shock loads and periodic excitations. Beside the expected large overall deformations more dramatic nonlinear influences are shown to occur from the inevitable imperfections of the struts. The conclusion also is that an active shape control, ensuring the straightness of the struts, seems to be mandatory for large space structures. ESA

N91-11789# Air Univ., Maxwell AFB, AL. Airpower Research Inst.
BUILDING BLOCKS IN SPACE
James D. Martens Apr. 1990 71 p
(AD-A224614; AU-ARI-89-6) Avail: NTIS HC/MF A04 CSCL 22/1

The role of standardization and modularity in solving operational acquisition, and supportability concerns is examined. The advantages, disadvantages, and difficulties of standardizing military space systems are evaluated. Modular construction is examined as a method of applying standardization to future spacecraft development. The conclusions suggest new alternatives for space vehicle construction during the next decade. GRA

N91-11790# Colorado Univ., Boulder.
SURVIVABILITY ENHANCEMENTS FOR MILITARY COMMUNICATIONS SATELLITES M.S. Thesis
Frederic Marc Arrendale 1990 124 p Sponsored by AFIT, Wright-Patterson AFB, OH
(AD-A224683; AFIT/CI/CIA-90-042) Avail: NTIS HC/MF A06 CSCL 15/6

Recognizing the various potential threats against the United States' military communications satellites and the criticality of their operation during times of national emergency, it is especially crucial that one accurately assess those threats and then design systems that are survivable against those threats. Their importance for instantaneous delivery of command and control information to the various strategic and tactical forces is invaluable and must be protected. The subject of military communications satellites is introduced and compared with their civilian counterparts from a survivability perspective, it will assess the threats against these command and control assets, and it will describe technological methods for enhancing their survival. The examination of these methods will include such topics as physical and EMP hardening, robustness or resistance to jamming, reconstitution of the network, and constellation designs which enhance survivability. Finally, conclusions are drawn and recommendations proposed based upon the discussion. GRA

N91-11791# Maryland Univ., College Park. Dept. of Electrical Engineering.
CONTROL OF COMPLEX MULTIBODY SPACECRAFT Annual Technical Report, 1 Dec. 1988 - 31 Dec. 1989
P. S. Krishnaprasad, Eyad Abed, Stuart Antman, John Baras, Carlos Berenstein, John Maddocks, Jerrold Marsden, and Juan Simo 31 Dec. 1989 14 p
(Grant AF-AFOSR-0073-87; AF Proj. 3484)
(AD-A224707; AFOSR-90-0807TR) Avail: NTIS HC/MF A03 CSCL 22/1

The Project C-MULTICS (Control of Complex Multibody Spacecraft) is a center of excellence at the University of Maryland. The modeling, analysis, control and simulation of large scale complex multibody spacecraft with rigid and flexible components is studied. GRA

N91-11792# Missouri Univ., Rolla. Dept. of Mechanical and Aerospace Engineering and Engineering Mechanics.
PHASE CHANGE MATERIAL FOR SPACECRAFT THERMAL MANAGEMENT Final Report, 1 Sep. 1988 - 31 Mar. 1989
J. W. Sheffield and C. Wen Apr. 1990 39 p
(Contract F33615-86-C-2721; AF Proj. 3145)
(AD-A224865; WRDC-TR-90-2029) Avail: NTIS HC/MF A03
CSCL 22/1

Processes related to phase change encompass a wide range of engineering and scientific disciplines and occur in many applications. Owing to the release or absorption of latent heat, these phase change problems are nonlinear, and exact solutions are limited to a small class of problems involving pure substances in 1-D infinite or semi-infinite domains. Based on an enthalpy formulation, several models were studied for solving the phase change heat transfer problem of melting. A continuum model is presented and utilized in a finite difference numerical method. Thermophysical properties of the PCM (Phase Change Material) such as mass density, specific heat, thermal conductivity, etc., change while the PCM undergoes the solid-liquid phase change. Accommodation methods for these variations were developed and are presented. The mathematical and numerical formulations of the conservation of mass, momentum and energy equations and thermodynamic property equations are presented in detail. Limited preliminary results for P116 wax show velocity vector fields and the liquidus lines during melting. GRA

N91-11793# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Dienstleistungsbereich.
EXPRESS: AN EXPERIMENTAL RETURN SERVICE FROM ORBIT [EXPRESS: EIN EXPERIMENT-RUCKKEHRSERVICE AUS DEM ORBIT]
P. Natenbruk and H. Wuenscher 1989 6 p In GERMAN Presented at DGLR-Jahrestagung, Hamburg, Fed. Republic of Germany, 2-4 Oct. 1989
(MBB-UO-0063-89-PUB; ETN-90-97849) Avail: NTIS HC/MF A02

The EXPRESS (Experiment Return Service from Space) concept is discussed. The short time development of this autonomous, and above all, operationally low cost flight program allows, on the one hand, an orbital microgravity utilization and on the other hand, the technological preparation for a higher re-entry capsule. As in Europe, the re-entry technology experience is still completely missing, the aims appear clearly. On the one hand, the development in the direction of the most simple capsule shape, the conical (Discoverer) form and on the other hand, the TEXUS experiment and some type flights must drive to the execution of the first measurement and test flights followed by qualification flights for the then available small carriers. The considered concept execution program could lead, with minimum risks, in about 3 years, to the first orbital flight. ESA

N91-11794# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Dienstleistungsbereich.
GUIDELINE FOR ORBITAL SERVICE TECHNOLOGY (LOS) [LEITKONZEPT FUER ORBITALE SERVICING TECHNOLOGIEN (LOS)]
L. Kerstein and U. Becker 1990 21 p In GERMAN Presented at Statusseminar des BMFT Automatisierungstechnologien fuer die Raumfahrt, Bad Honnef, Fed. Republic of Germany, 13-14 Feb. 1990 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H.
(MBB-UO-0083-90-PUB; ETN-90-97850) Avail: NTIS HC/MF A03

The aim of the LOS (German acronym) project is to create a guidance concept technology for unmanned servicing. The technological guiding concept that is used as a basis and reference for the coordinates, the requirement adapted development, and the correletion, of requisite service technology, takes the following aspects into account: applicability of service technology in future space travel system; development steps for orbital servicing; cross section technology for residual space travel technical ranges; lead themes for a technical program of orbital servicing. ESA

N91-11765# Technische Univ., Delft (Netherlands).
SEMI PASSIVE ATTITUDE STABILIZATION FOR A GEODETIC SATELLITE
P. P. vandenBroek *In its* Essays on Stability and Control Oct. 1989 22 p (For primary document see N91-11759 03-09)
Avail: NTIS HC/MF A12

N91-11821# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (Germany, F.R.). Dept. of Space.
ARIANE CAPSULE: PHASE B1 STUDY ON STRUCTURE SUBSYSTEM
J. Ehrhardt, T. Schaeffler, and J. Zaun *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 63-70 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11836# Norske Veritas, Oslo.
IN ORBIT IN-SERVICE INSPECTION
O. Forli *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 157-161 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11847# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.).
MULTIWALL THERMAL PROTECTION SYSTEM ENGINEERING ASPECTS
H. Grallert and K. Keller (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 227-231 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11848# Societe Europeenne de Propulsion, Saint-Medard-en-Jalles (France).
DEVELOPMENT OF C/SIC LARGE PARTS TECHNOLOGY FOR AEROSPACE PLANE THERMAL STRUCTURES
Alain Lacombe, Jean-Michel Rouges, and Pierre Taveau *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 233-239 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11861# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
SHIELDING AGAINST ORBITAL DEBRIS: A CHALLENGING PROBLEM
Michel Lambert *In its* Space Applications of Advanced Structural Materials Jun. 1990 p 319-328 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11870# British Aerospace Public Ltd. Co., Stevenage (England).
COST OPTIMISATION OF LOAD CARRYING STRUCTURES
B. A. Reid and A. Pradier (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 397-402 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11873# Aerospatiale Aquitaine, Saint-Medard en Jalles (France). Strategic and Space Div.
SIMOUN: NEW TEST METHODS FOR DEVELOPMENT WORK ON THE HERMES THERMAL PROTECTION SYSTEMS [SIMOUN: UN NOUVEAU MOYEN D'ESSAIS POUR LE DEVELOPPEMENT DES PROTECTIONS THERMIQUES D'HERMES]
P. Charpentier and R. Leroux *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 419-425 In FRENCH (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-12402*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
OVERVIEW OF SPACE STATION
Claude C. Priest *In its* Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 25 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22B

N91-12403*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DESIRABLE LIMITS OF ACCELERATIVE FORCES IN A SPACE-BASED MATERIALS PROCESSING FACILITY
Robert J. Naumann *In its* Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 18 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22B

N91-12422*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
LOW-g PAYLOAD PLACEMENT CONSTRAINTS FOR SPACE STATION
Anita S. Carpenter and Stanley N. Carroll *In its* Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 14 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22B

N91-12423*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE STATION DYNAMICS
Reg Berka *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 34 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22B

N91-12424*# Boeing Aerospace Co., Seattle, WA.
SPACE STATION STRUCTURAL PERFORMANCE EXPERIMENT
Dick Gates *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 11 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22B

N91-12425*# Lockheed Missiles and Space Co., Sunnyvale, CA.
EFFECT OF SCIENCE LABORATORY CENTRIFUGE OF SPACE STATION ENVIRONMENT
Nancy Searby *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 17 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22B

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N91-11795# Sira Inst. Ltd., Chislehurst (England).
A MEDIUM RESOLUTION IMAGING SPECTROMETER
M. A. Cutter and D. R. Lobb 1990 12 p Presented at Royal Aeronautical Society Conference on Earth Observation Satellites: The Technology Behind the Image, 17-18 Jan. 1990
(ETN-90-97967) Avail: NTIS HC/MF A03

The technological aspects of the Medium Resolution Imaging Spectrometer (MERIS), proposed as a candidate core instrument for the European Polar Platform scheduled for launch in 1997, are described. The instrument has a spectral range of 400 to 1050 nm, a swath width of 1500 km, a spectral resolution of 1.25 nm and a spatial resolution of 260 m. The instrument has applications in environmental studies including the fields of marine, land and atmospheric research. ESA

N91-12411*# Teledyne Brown Engineering, Huntsville, AL.
MSL-2 ACCELEROMETER DATA RESULTS
Fred Henderson *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 29 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

N91-12412*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MECHANICAL ISOLATION FOR GRAVITY GRADIOMETERS
David Sonnabend *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 12 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

N91-12413*# Textron Bell Aerospace Co., Belmont, CA.
THE MESA ACCELEROMETER FOR SPACE APPLICATION
William G. Lange and Robert W. Dietrich *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 28 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

N91-12414*# Payload Systems, Inc., Wellesley, MA.
A NEW ACCELEROMETER RECORDING SYSTEM FOR SHUTTLE USE
Byron Lichtenberg *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 18 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

N91-12415*# Honeywell, Inc., Minneapolis, MN. Systems and Research Center.
NEW ACCELEROMETERS UNDER DEVELOPMENT
Jerry Wald and M. Tehrani *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 20 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

N91-12416*# Maryland Univ., College Park.
SUPERCONDUCTING SIX-AXIS ACCELEROMETER
H. J. Paik *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 14 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

N91-12417*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PRESENTATION ON A SPACE ACCELERATION MEASUREMENT SYSTEM (SAMS)
Theodore L. Chase *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 20 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

N91-12418*# Teledyne Geotechnical, Dallas, TX.
ACQUISITION AND ANALYSIS OF ACCELEROMETER DATA
Keith R. Verges *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 32 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

N91-12419*# Applied Technology Associates, Inc., Albuquerque, NM.
CHARACTERIZING PERFORMANCE OF ULTRA-SENSITIVE ACCELEROMETERS
Henry Sebesta *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 27 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

N91-12426*# Sundstrand Data Control, Inc., Redmond, WA.
NOISE POWER SPECTRAL DENSITY OF THE SUNDSTRAND QA-2000 ACCELEROMETER
Rex Peters, David Grindeland, and Charles R. Baugher, ed. (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.) *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 6 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

N91-12427*# Teledyne Brown Engineering, Huntsville, AL.
THE PERFECTLY IDEAL ACCELEROMETER
Ernst Stuhlinger *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 20 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N91-11796*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
STATUS OF STRUCTURAL ANALYSIS OF 30 cm DIAMETER ION OPTICS
Gregory S. MacRae and Gary T. Hering 1990 17 p Presented at the 21st International Electric Propulsion Conference, Orlando, FL, 18-20 Jul. 1990; cosponsored by AIAA, DGLR, and JSASS
(NASA-TM-103618; E-5775; NAS 1.15:103618; AIAA-90-2649)
Avail: NTIS HC/MF A03 CSCL 21H

Three structural finite element programs are compared with theory, experimental data, and each other to evaluate their usefulness for modeling the thermomechanical deflection of ion engine electrodes. Two programs, NASTRAN and MARC, used a Cray XMP and the third, Algor, used an IBM compatible personal computer. The shape of the applied temperature gradient greatly affects off-axis displacement, implying that an accurate temperature distribution is required to analyze new designs. The use of bulk material constants to model the perforated electrodes was investigated. The stress and displacement predictions are shown to be sensitive to the temperature gradient and the Young's modulus, and insensitive to number of nodes, above some minimum value, and the Poisson ratio used. The models are shown to be useful tools for evaluating designs. Experimental measurements of temperatures and displacements was identified as the most critical area. Author

N91-11797*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ADVANCED LAUNCH VEHICLE UPPER STAGES USING LIQUID PROPULSION AND METALLIZED PROPELLANTS
B. A. Palaszewski 1990 24 p Presented at the 1990 JANNAF Propulsion Meeting, Anaheim, CA, 3-5 Oct. 1990
(NASA-TM-103622; E-5779; NAS 1.15:103622) Avail: NTIS HC/MF A03 CSCL 21H

Metallized propellants are liquid propellants with a metal additive suspended in a gelled fuel or oxidizer. Typically, aluminum particles are the metal additives. These propellants provide increase in the density and/or the specific impulse of the propulsion system. Using metallized propellants for volume- and mass-constrained upper stages can deliver modest increases in performance for Low Earth Orbit to Geosynchronous Earth Orbit and other Earth orbital transfer missions. Metallized propellants, however, can enable very fast planetary missions with a single-stage upper stage system. Trade studies comparing metallized propellant stage performance with non-metallized upper stages and the Inertial Upper Stage are presented. These upper stages are both one- and two-stage vehicles that provide the added energy to send payloads to altitudes and onto trajectories that are unattainable with only the launch vehicle. The stage designs are controlled by the volume and the mass constraints of the Space Transportation System and Space Transportation System-Cargo launch vehicles. The influences of the density and specific impulse increases enabled by metallized propellants are examined for a variety of different stage and propellant combinations. Author

N91-11798*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
XENON ION PROPULSION FOR ORBIT TRANSFER
V. K. Rawlin, M. J. Patterson, and R. P. Gruber Jul. 1990 30 p Presented at the 21st International Electric Propulsion Conference, Orlando, FL, 18-20 Jul. 1990; sponsored in part by AIAA, DGLR, and JSASS
(NASA-TM-103193; E-5586; NAS 1.15:103193; AIAA-90-2527)
Avail: NTIS HC/MF A03 CSCL 21H

For more than 30 years, NASA has conducted an ion propulsion program which has resulted in several experimental space flight demonstrations and the development of many supporting technologies. Technologies appropriate for geosynchronous stationkeeping, earth-orbit transfer missions, and interplanetary missions are defined and evaluated. The status of critical ion propulsion system elements is reviewed. Electron bombardment ion thrusters for primary propulsion have evolved to operate on xenon in the 5 to 10 kW power range. Thruster efficiencies of 0.7 and specific impulse values of 4000 s were documented. The baseline thruster currently under development by NASA LeRC includes ring-cusp magnetic field plasma containment and dished two-grid ion optics. Based on past experience and demonstrated simplifications, power processors for these thrusters should have approximately 500 parts, a mass of 40 kg, and an efficiency near 0.94. Thrust vector control, via individual thruster gimbals, is a mature technology. High pressure, gaseous xenon propellant storage and control schemes, using flight qualified hardware, result in propellant tankage fractions between 0.1 and 0.2. In-space and ground integration testing has demonstrated that ion propulsion systems can be successfully integrated with their host spacecraft. Ion propulsion system technologies are mature and can significantly enhance and/or enable a variety of missions in the nation's space propulsion program. Author

N91-11799*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
UNSTEADY BLADE-SURFACE PRESSURES ON A LARGE-SCALE ADVANCED PROPELLER: PREDICTION AND DATA
M. Nallasamy (Sverdrup Technology, Inc., Brook Park, OH.) and J. F. Groeneweg Jul. 1990 15 p Presented at the 26th Joint Propulsion Conference, Orlando, FL, 16-18 Jul. 1990; sponsored in part by AIAA, SAE, ASME, and ASEE Previously announced in IAA as A90-47220 Original contains color illustrations
(Contract NAS3-24105)
(NASA-TM-103218; E-5630; NAS 1.15:103218) Avail: NTIS HC/MF A03; 1 functional color page CSCL 21H

An unsteady 3-D Euler analysis technique is employed to compute the flow field of an advanced propeller operating at an angle of attack. The predicted blade pressure waveforms are

compared with wind tunnel data at two Mach numbers, 0.5 and 0.2. The inflow angle is three degrees. For an inflow Mach number of 0.5, the predicted pressure response is in fair agreement with data: the predicted phases of the waveforms are in close agreement with data while the magnitudes are underpredicted. At the low Mach number of 0.2 (takeoff), the numerical solution shows the formation of a leading edge vortex which is in qualitative agreement with measurements. However, the highly nonlinear pressure response measured on the blade suction surface is not captured in the present inviscid analysis. Author

N91-11800*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
METALLIZED PROPELLANTS FOR THE HUMAN EXPLORATION OF MARS
Bryan A. Palaszewski Nov. 1990 14 p
(NASA-TP-3062; E-5544; NAS 1.60:3062) Avail: NTIS HC/MF A03 CSCL 21H

Advanced chemical propulsion using Metallized Propellants (MP) can lead to significant reductions in launch mass for piloted Mars missions. MP allow the propellant density or the specific impulse I(sub sp) of the propulsion system, or both, to increase. It can reduce the propellant mass and the propulsion system dry mass. Detailed mass-scaling equations and estimates of the I(sub sp) for several MP combinations are presented. The most significant savings with MP are derived from increasing the payload delivered to Mars. For the mass in low Earth orbit (LEO), a metallized Mars transfer vehicle can deliver 20 to 22 percent additional payload. This 20-percent payload increase reduces the total number of Mars flights and therefore significantly reduces the number of Space Transportation System-Cargo launches for the entire Mars architecture. Using MP to reduce the mass in LEO per flight is not as effective as increasing the payload delivery capacity. The mass saving per flight, while delivering the same payload with a higher I(sub sp) system, is much smaller. Using MP in all of the Mars propulsion systems would produce a modest 3.3 percent LEO mass saving. This translates into a saving of 38,000 kg over the mass required with O2/H2 propulsion. A Mars excursion vehicle using Earth- or space-storable propellants for the ascent can be an alternative to storing cryogenic H2 on Mars. A space-storable system using oxygen/monomethyl hydrazine/aluminum (02/MMH/Al) would deliver the lowest mass penalty over O2/H2. For lower-energy expedition missions the LEO mass penalty for using metallized O2/MMH/Al would be only 3 to 5 percent.
Author

N91-11801*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
REAPPRAISAL OF SOLID SELECTIVE EMITTERS
Donald L. Chubb May 1990 16 p Presented at the 21st Photovoltaic Specialists Conference, Kissimmee, FL, 21-25 May 1990; sponsored in part by IEEE
(NASA-TM-103290; E-5750; NAS 1.15:103290) Avail: NTIS HC/MF A03 CSCL 21H

New rare earth oxide emitters show greater efficiency than previous emitters. As a result, based on a simple model the efficiency of these emitters was calculated. Results indicate that the emission band of the selective emitter must be at relatively low energy (less than or equal to .52 eV) to obtain maximum efficiency at moderate emitter temperatures (less than or equal to 1500 K). Thus low bandgap energy PV materials are required to obtain an efficient thermophotovoltaic (TPV) system. Of the 4 specific rare earths (Nd, Ho, Er, Yb) studied Ho has the largest efficiency at moderate temperatures (72 percent at 1500 K). A comparison was made between a selective emitter TPV system and a TPV system that uses a thermal emitter plus a band pass filter to make the thermal emitter behave like a selective emitter. Results of the comparison indicate that only for very optimistic filter and thermal emitter properties will the filter TPV system have a greater efficiency than the selective emitter system. Author

N91-11802*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A 10,000-HR LIFE TEST OF AN ENGINEERING MODEL RESISTOJET
Rodger J. Slutz Oct. 1990 17 p
(NASA-TM-103216; E-5627; NAS 1.15:103216) Avail: NTIS HC/MF A03 CSCL 21H

One of the major issues associated with using resistojet thrusters on Space Station Freedom is the long life required. An engineering model resistojet was life-tested to determine if it was capable of meeting that requirement. This thruster, which was designed for 10,000 hr of operation at 2552.4 F (1400 C) or less under cyclical thermal conditions, successfully operated for 10,036 hr at 1836 F (1002 C) while undergoing 141 thermal cycles.
Author

N91-11803# Naval Postgraduate School, Monterey, CA. Dept. of Aeronautics and Astronautics.
A COMBINED OPTICAL AND COLLECTION PROBE FOR SOLID PROPELLANT EXHAUST PARTICLE ANALYSIS M.S. Thesis
Timothy J. Eno Dec. 1989 70 p Sponsored by Air Force Astronautics Lab., Edwards AFB, CA
(AD-A225330) Avail: NTIS HC/MF A04 CSCL 21/8

A combined optical and collection probe for solid propellant rocket motor exhaust particle analysis was designed and utilized in initial experiments with a sub-scale rocket motor. Shock swallowing capabilities of the probe were verified under restricted motor operations using a schlieren system. Window purge and ejector design were shown to be capable of keeping the probe windows clean when the probe was placed approximately 14 nozzle diameters downstream of the exhaust nozzle. The exhaust deflection device allowed sampling to occur during the minimum time required to reach steady flow within the probe. A MALVERN Mastersizer was used for in situ measurements to the particles, and a collection filter at the aft end of the probe was partially successful in capturing the probe flow. Suggestions are made for probe improvements and future investigations. GRA

N91-11804# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
RESEARCH ON HIGH PERFORMANCE ORGANIC SILICON ABLATIVE MATERIALS FOR USE IN SOLID ROCKET MOTORS
Weijun Sun 6 Jun. 1990 14 p Transl. into ENGLISH from Binggong Xuebao (Peoples Repubic of China), no. 3, Aug. 1989 p 39-44
(AD-A225345; FTD-ID(RS)R-0125-90) Avail: NTIS HC/MF A03 CSCL 11/4

This Chinese translation discusses the effects of the structure of organic silicon resins (R/Si and Me/Ph molecule chain forms and comonomer structures) on the thermal stability of materials and ablative properties. Opting for the use of special composite techniques and precise formulation designs, it is possible to compound resins with structures that are linear and branched. They have small weight losses under heat. The char yield ratios are high. The charring layers have great strength, and anti-scouring properties are good. Using endothermic chemical reactions that occur at high temperatures between fillers in order to design materials for formulation, it is possible to effectively lower the cold wall temperature, improving ablative properties. GRA

N91-11805# Air Force Office of Scientific Research, Bolling AFB, Washington, DC.
PROCEEDINGS OF THE AFOSR/ONR CONTRACTORS MEETING, COMBUSTION, ROCKET PROPULSION, DIAGNOSTICS OF REACTING FLOW Technical Report, 11-15 Jun. 1990
M. A. Birkan, J. M. Tishkoff, and G. S. Roy 15 Jun. 1990 315 p Meeting held in Atlanta, GA, 11-15 Jun. 1990
(AD-A225444; AFOSR-90-0808TR) Avail: NTIS HC/MF A14 CSCL 21/2

There is a strong need to improve our fundamental

understanding of electrothermal arcjets with the ultimate goal of increasing both efficiency and specific impulse. A research effort using emission spectroscopy, two-color pyrometry and analytical modeling is being developed to better understand and minimize the major energy loss mechanisms in arcjet thrusters, for example; anode heat losses, viscous losses and frozen flow losses. Research in these areas will assist in optimizing the overall design configuration and thermal characteristics of arcjet propulsion devices. GRA

N91-11854# FDO Technische Adviseurs B.V. (Netherlands).
RESULTS OF POST FIRING EXAMINATIONS OF IGNITER NOZZLES OF THE VULCAIN ENGINE
J. E. Buter and G. K. Troost (Stork Product Engineering, Amsterdam, Netherlands) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 273-276 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11855# Societe Europeenne de Propulsion, Saint-Medard-en-Jalles (France). Div. Propulsion a Liquides et Espace.
CMC MATERIALS FOR A HIGH PERFORMANCE 20 N THRUSTER
A. Mathieu and E. Soler *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 277-282 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11856# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart (Germany, F.R.). Inst. for Structures and Design.
DEVELOPMENT AND REAL-TEST OF A RAMJET NOZZLE MADE OF LIQUID-SILICON-INFILTRATED C/SiC
H. Hald, P. Szasz, and K. Dittrich *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 283-289 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

23 CHEMISTRY AND MATERIALS (GENERAL)

N91-11806*# Case Western Reserve Univ., Cleveland, OH.
LOW TEMPERATURE SYNTHESIS OF CaO-SiO2 GLASSES HAVING STABLE LIQUID-LIQUID IMMISCIBILITY BY SOL-GEL PROCESS Final Report
Narottam P. Bansal Oct. 1990 40 p
(Contract NCC3-133)
(NASA-CR-185293; E-5740; NAS 1.26:185293) Avail: NTIS HC/MF A03 CSCL 07A

Calcium silicate glass compositions lying within the liquid-liquid immiscibility dome of the phase diagram, which could not have been prepared by the conventional melting method, were synthesized by the sol-gel process. Hydrolysis and polycondensation of tetraethyl orthosilicate (TEOS) solutions containing up to 20 mol percent calcium nitrate resulted in the formation of clear and transparent gels. The gel formation time decreased with increase in water:TEOS mole ratio, calcium content, and the reaction temperature. Smaller values of gel times in the presence of calcium nitrate are probably caused by lowering of the ionic charge on the sol particles by the salt present. The gelation activation energy, E(sub gel), was evaluated from temperature dependence of the gel time. Presence of Ca(2+) ions or the water:TEOS mole ratio did not have an appreciable effect on the value of E(sub gel). Presence of glycerol in the solution helped in the formation of crack-free monolithic gel specimens. Chemical and structural changes occurring in the gels, as a function of the heat treatments, have been monitored using DTA, TGA, IR-spectroscopy, x ray diffraction, surface area and pore size distribution measurements. Author

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials.*

N91-11807 Michigan Univ., Ann Arbor.
NONLINEAR COMPUTATIONAL MODELS FOR COMPOSITE MATERIALS USING HOMOGENIZATION Ph.D. Thesis
Jose MirandaGuedes 1990 192 p
Avail: Univ. Microfilms Order No. DA9023602

Computational models that describe the overall mechanical response and the microstructure behavior of composite materials are developed. The models presented are restricted to two different classes: the small deformation of linear elastic composites and the large deformation of elasto-plastic composites. It is further assumed that the composite materials can be represented by a periodic repetition of a microstructural unit. The homogenization theory is used to derive models characterizing both the macroscopic and the microscopic mechanical behavior of the composite, and the finite element method used for their computational implementation. For the case of small deformation of linear elastic composites, the accuracy of the finite element method is studied. A priori error estimations are derived and the convergence properties are discussed. The ideas of material pre-processor and material post-processor are introduced. Examples for local stress analysis are presented. An adaptive finite element method based on the a priori error estimations is also implemented to improve the accuracy of the approximations. For the case of large deformation elasto-plasticity of composites, an incremental method is developed. The constitutive equation for the components of the composite assumes time independent plasticity, additive decomposition of the velocity gradient, isotropic and kinematic hardening, and a normal flow rule. The particular case of J2 flow theory of plasticity with isotropic and kinematic hardening is considered. The method is applied to local stress and plasticity analysis of general two dimensional structures, as well as to investigate the macroscopic properties of the composites. The macroscopic behavior is shown to depend significantly on the geometry of the microstructure and is rather different from that of the constituents of the composite material. Dissert. Abstr.

N91-11808*# Sikorsky Aircraft, Stratford, CT.
FLIGHT SERVICE EVALUATION OF COMPOSITE HELICOPTER COMPONENTS Final Report, Feb. 1981 - Nov. 1990
George H. Mardoian and Maureen B. Ezzo Nov. 1990 142 p
(Contract NAS1-16542)
(NASA-CR-182063; NAS 1.26:182063; SER-510349) Avail: NTIS HC/MF A07 CSCL 11D

An assessment is presented of ten composite tail rotor spars and four horizontal stabilizers exposed to the effects of in-flight commercial service for up to nine years to establish realistic environmental factors for use in future designs. This evaluation is supported by test results of helicopter components and panels which have been exposed to outdoor environmental effects since 1979. Full scale static and fatigue tests were conducted on graphite/epoxy and Kevlar/epoxy composite components removed from Sikorsky Model S-76 helicopters in commercial operations off the Gulf Coast of Louisiana. Small scale static and fatigue tests were conducted on coupons obtained from panels exposed to outdoor conditions in Stratford, CT and West Palm Beach, Florida. The panel materials and ply configurations were representative of the S-76 components. The results are discussed of moisture analyses and strength tests on both the S-76 components and composite panels after up to nine years of outdoor exposure. Full scale tests performed on the helicopter components did not disclose any significant reductions from the baseline strengths. The results increased confidence in the long term durability of advanced composite materials in helicopter structural applications. Author

N91-11809*# Lockheed Engineering and Sciences Co., Hampton, VA.
THERMOPLASTIC POLYIMIDE NEW-TPI (TRADEMARK)

Tan-Hung Hou and Rakasi M. Reddy (Old Dominion Univ., Norfolk, VA.) Oct. 1990 40 p
(Contract NAS1-19000; NAG1-569)
(NASA-CR-187445; NAS 1.26:187445) Avail: NTIS HC/MF A03 CSCL 11D

Thermal and rheological properties of a commercial thermoplastic polyimide, NEW-TPI (trademark), were characterized. The as-received material possesses initially a transient crystallite form with a bimodal distribution in peak melting temperatures. After the melting of the initial crystallite structure, the sample can be recrystallized by various thermal treatments. A bimodal or single modal melting peak distribution is formed for annealing temperatures below or above 360 C, respectively. The recrystallized crystallinities are all transient in nature. The polymers are unable to be recrystallized after being subjected to elevated temperature annealing above 450 C. The recrystallization mechanism was postulated, and a simple kinetics model was found to describe the behavior rather satisfactory under the conditions of prolonged thermal annealing. Rheological measurements made in the linear viscoelastic range support the evidence observed in the thermal analysis. Furthermore, the measurements sustain the manufacturer's recommended processing window of 400 to 420 C for this material. Author

N91-11810 Carnegie-Mellon Univ., Pittsburgh, PA.
PREDICTION OF THE ULTIMATE TENSILE STRENGTH OF A FIBER-REINFORCED CERAMIC Ph.D. Thesis
Hendrik Reinier Schwietert 1990 148 p
Avail: Univ. Microfilms Order No. DA9026781

A theory for calculating the ultimate tensile strength of an infinite, ceramic-matrix fiber composite is presented. At some stress level which is less than the ultimate strength, the composite is presumed to undergo multiple matrix cracking; this results in intact fibers spanning a series of roughly equally spaced matrix cracks. Subsequent damage in the form of fiber breaks is assumed to occur with the fiber strength being statistically distributed. With the use of some plausible assumptions, the spatial distribution of fiber breaks is computed and their effect on the subsequent load carrying capacity of the composite is determined. The stress distributions in the broken and in the intact fibers are considered and incorporated in the theory. The problem of a broken fiber, embedded in an infinite medium with distinct elastic properties, is studied. The composite is subjected to tensile loading parallel to the fiber. An interface integral equation method is developed to solve this problem. This method reduces the specific problem considered to four coupled integral equations which are solved numerically. The analysis shows that the average axial fiber stress can be estimated with a constant shear stress approximation reasonably well. Comparison of the predictions with the actual measured strengths shows that, although some of the results are promising, most predictions overestimate the strength. The differences between the predicted and measured strengths can be explained by inaccuracies in the experimental data. The ultimate tensile strength depends sensitively on the interfacial shear stresses, the fiber strength variability, and the mean fiber strength. Furthermore, a possible stress enhancement in the fibers near the matrix cracks can reduce the ultimate tensile strength considerably. Dissert. Abstr.

N91-11811# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
BASIC MATERIAL DATA AND STRUCTURAL ANALYSIS OF FIBER COMPOSITE COMPONENTS FOR SPACE APPLICATION
H. Bansemir and O. Haider 1990 25 p Presented at ICMC International Cryogenic Materials Conference on Nonmetallic Materials and Composites at Low Temperatures, Heidelberg, Fed. Republic of Germany, 17-18 May 1990
(MBB-UD-582-90-PUB; ETN-90-97887) Avail: NTIS HC/MF A03

Fiber composites are widely used for space applications such as antennas, solar arrays, and support structures for cryogenic tanks. For the calculation of the mechanical behavior of composite structures basic material data is presented. Main mechanical properties are thermal conductivity, thermal expansion, stiffness, and strength for the unidirectional material. Special fiber orientations and lay ups are used in order to optimize the laminates, taking special requirements into account. The optimized design for some composite parts for different space applications are shown, especially pointing out the aspects of the structural analysis and the tests performed to check the calculations. ESA

N91-11812# European Space Agency, Paris (France).
SPACE APPLICATIONS OF ADVANCED STRUCTURAL MATERIALS
W. R. Burke, comp. Jun. 1990 433 p In ENGLISH and FRENCH Symposium held in Noordwijk, Netherlands, 21-23 Mar. 1990
(ESA-SP-303; ISBN-92-9092-054-8; ISSN-0379-6566;
ETN-90-97990) Copyright Avail: NTIS HC/MF A19

The use of new structural materials and technology in spacecraft construction and development is discussed. Mirrors and reflectors, hot materials, joining and welding techniques and nondestructive testing of materials are described. Composite fiber reinforced plastics are discussed. Multiwall thermal protection and hot structures are outlined. New materials and techniques for pressure vessel and nozzle construction are described. Metals, metallic composites and functionally gradient materials are discussed. Design allowables and cost parameters are reviewed. Material testing and intelligent structures are discussed. For individual titles, see N91-11813 through N91-11877.

N91-11813# Stanford Univ., CA. Dept. of Aeronautics and Astronautics.
PROCESSING COMPOSITES
George S. Springer *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 3-14 (For primary document see N91-11812 03-24)
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The role of analytical models in autoclave curing and filament winding is described. The use of models simulating the manufacturing process to select the optimum process variables, including applied heat and pressure during autoclave cure, winding speeds, fiber tension, and applied heat during filament winding, is shown. The application of the models to real time control of automated manufacturing of composites is discussed. ESA

N91-11814# Commission of the European Communities, Brussels (Belgium). Directorate General for Science Research and Development.
THE 1989-1992 ACTIVITIES: THE BRITE EURAM PROGRAMME IN THE FIELD OF ADVANCED STRUCTURAL MATERIALS
H. Pero and C. Tokamanis *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 15-18 (For primary document see N91-11812 03-24)
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The BRITE/EURAM program designed to improve the technological competitiveness of European companies is described. Application of new industrial technology and new materials within the European industry is one of the goals of the program. Programs in the fields of metallic materials and metallic matrix composites are described. Materials for magnetic, optical, electrical and superconducting applications are discussed. High temperature nonmetallic materials, polymers and organic matrix composites are outlined. Priority themes guiding development of the BRITE/EURAM program are listed. ESA

N91-11815# Construcciones Aeronauticas S.A., Madrid (Spain).
COMPACT PAYLOAD TEST RANGE: REFLECTORS DEVELOPMENT **c14**
Antonio Jimenez *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 21-25 (For primary document see N91-11812 03-24)
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Work performed on the reflectors of a compact test range during design and definition stages is described. Carbon fiber sandwich technology is employed in manufacturing the eight panels

of the two reflectors. The dimensions of each panel is about ten by two meters. In order to meet tight surface accuracy requirements prepreg is selected to eliminate thermal distortions during the curing. Results of finite element analysis for each reflector are presented. A best fit analysis used to obtain the surface accuracy of the reflectors is described. ESA

N91-11816# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A PHENOMENOLOGICAL MODEL OF COATING/SUBSTRATE ADHESION AND INTERFACIAL BIMETALLIC PEELING STRESS IN COMPOSITE MIRRORS **c27**
Paul M. McElroy and Daniel D. Lawson *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 27-34 (For primary document see N91-11812 03-24)
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Adhesion and interfacial stress between metal films and structural composite material substrates is discussed. A theoretical and conceptual basis for selecting coating materials for composite mirror substrates is described. A phenomenological model that interrelates cohesive tensile strength of thin film coatings and interfacial peeling stresses is presented. The model serves as a basis in determining gradiated materials response and compatibility of composite substrate and coating combinations. Parametric evaluation of material properties and geometrical factors such as coating thickness are used to determine the threshold stress levels for maintaining adhesion at the different interfaces. ESA

N91-11817# Ericsson Radar Electronics A.B., Molndal (Sweden).
METALLISATION METHODS AND APPLICATIONS **c27**
D. Joensson *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 35-38 (For primary document see N91-11812 03-24)
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Three different methods of metallization of composite materials bonding or cocuring, indirect metallization and galvanic metallization, are described. These methods are of vital importance in making use of composite materials for antenna applications. Bonding or cocuring of conductive foils is used for microstrip antennas, external coatings of waveguides and for grounding purposes. Indirect metallization uses a premetallized mandrel. The galvanic method can be applied after curing. Examples and applications of the different methods are described. ESA

N91-11818# Aerospatiale Aquitaine, Saint-Medard en Jalles (France). Strategic and Space Div.
STRUCTURAL MATERIALS FOR SPACE MIRRORS **c74**
C. Capitanio *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 39-43 (For primary document see N91-11812 03-24)
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Work leading to the development of XMM telescope mirrors is described. Although a carbon/epoxy composite structure was specified, a hot type of material was proposed. The further use of such technology in the development of substrates for space mirrors is discussed. The specifications for the plane plates used for the XMM telescope are presented. The advantages and disadvantages of various other materials in producing substrates for space mirrors are discussed. The potential uses of glass matrix ceramics reinforced with carbon or silicon carbide fibers is given particular attention. ESA

N91-11819# Contraves Corp., Zurich (Switzerland). Space Div.
OPTICAL INTERFEROMETER SYSTEMS IN SPACE: CONFIGURATION AND STRUCTURE CONCEPTS USING SPACE RIGIDIZED ELEMENTS **c74**
M. C. Bernasconi, S. Koese, and W. J. Rits (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 47-56 Previously announced in IAA as A90-13554 (For primary document see N91-11812 03-24)
(Contract ESA-6975/86/NL/PH)
Copyright Avail: NTIS HC/MF A19

The use of inflatable space-rigidized structures for use in orbital optical interferometry systems is discussed. Their ability to provide 100 m long supporting elements for such interferometers is analyzed. It is found that such systems can be built and packaged for launch to geostationary orbit by Ariane 5 with specific masses of 0.8 to 1.8 kg/m. They can be stiff enough to be controllable, and provide interfaces for observing telescopes sufficiently free of vibration for sensor scanning frequencies. The use of such optical interferometric methods is discussed. ESA

N91-11820# Cray Advanced Materials Ltd., Yeovil (England).
MANUFACTURE OF CARBON FIBRE REINFORCED STRUCTURAL TUBULAR STRUTS USING THE LIQUID PRESSURE FORMING PROCESS
L. B. Duffy *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 57-62 (For primary document see N91-11812 03-24)
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A Liquid Pressure Forming (LPF) net shape process for the production of metal matrix composites is described. Techniques for using the process in the manufacture of a tubular strut with high stiffness and a low coefficient of thermal expansion along its length are discussed. Re-design of the strut such that end fittings are an integral part of the design is described. An ultra high modulus carbon fiber is selected for use in making the strut. Other structures produced using the LPF technique are outlined. ESA

N91-11821# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (Germany, F.R.). Dept. of Space.
ARIANE CAPSULE: PHASE B1 STUDY ON STRUCTURE SUBSYSTEM **c18**
J. Ehrhardt, T. Schaeffler, and J. Zaun *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 63-70 (For primary document see N91-11812 03-24)
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The Ariane capsule intented for launch on Ariane 4 and 5 as an auxiliary payload is described. Tests carried out during the B1 phase of the capsule structure subsystem testing are described. The strategy followed in carrying out the mechanical and thermal load tests is outlined. A finite element model using aluminum metal properties is used in the testing analysis. Results from various calculations show stress levels exceeding rupture strength and unacceptable deformation of the heat shield. Updating of the finite element model using fiber reinforced structural elements where needed is outlined. ESA

N91-11822# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Central Labs.
THE APPLICATION OF THREE-DIMENSIONAL FIBRE PREFORMS FOR AEROSPACE COMPOSITE STRUCTURES
J. Brandt, K. Drechsler, and R. Meistring *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 71-77 (For primary document see N91-11812 03-24)
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The design, manufacture and mechanical properties of three dimensional composites with organic matrices are described. Integrally woven sandwich structures are studied. The data indicates that such woven structures have great potential for structural applications where conventional two dimensional laminated composites may prematurely fail due to low damage tolerance and impact performance. Improvement in damage tolerance is demonstrated by compression-after-impact tests. Local restriction of damage is shown to be one of the features of the three dimensional structure. The wide variety of fiber architectures and shapes allowed by three dimensional preforms are described. ESA

N91-11823# Construcciones Aeronauticas S.A., Madrid (Spain). Space Div.
THE DEVELOPMENT OF THE ARIANE-4 ADAPTOR 937B **c15**

A. Jimenez, J. Pascual, J. Lechon, and J. Aceituna *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 79-84 (For primary document see N91-11812 03-24)
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The Carbon Fiber Reinforced Plastic (CFRP) sandwich shell Ariane 4 payload adapter 937B is described. Two interface metallic end rings are incorporated in the design. The overall dimensions of the adapter are described. The main feature of the adapter is the use of cocuring technology in manufacturing the entire adapter sandwich shell in one piece. Manufacturing cost reductions are described. Qualification test results are presented. Mathematical models used in design analysis of the adapter are outlined. ESA

N91-11824# Aerospatiale Aquitaine, Saint-Medard en Jalles (France). Strategic and Space Div.
OXIDATION RESISTANT CARBON/CARBON MATERIALS
O. Franc and J. L. Macret *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 87-90 (For primary document see N91-11812 03-24)
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Work carried out in the development of oxidation resistant thermostructural materials is described. Ceramic Matrix Composites (CMC) and oxidation resistant carbon/carbon (C/C INOX) materials are given particular attention. Work carried out on glass ceramic matrix composites is outlined. Possible applications of C/C INOX materials in the hot structures of space planes such as Hermes, in ramjet and supersonic ramjet engines and in hypersonic missiles and aircraft are discussed. Limitations of CMC for high temperature applications are described. ESA

N91-11825# Schunk Kohlenstofftechnik G.m.b.H., Giessen (Germany, F.R.).
OXIDATION INHIBITED CARBON/CARBON: A CANDIDATE MATERIAL FOR HOT STRUCTURES
W. Huettner, R. Weiss, G. Dietrich, and R. Meistring (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich, Germany, F.R.) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 91-95 (For primary document see N91-11812 03-24)
(Grant BMFT-03M1019BO)
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The high temperature mechanical properties and oxidation protection of carbon-carbon composites are discussed. Strength up to 1800 C without losing damage tolerance is measured. The potential of multilayer coatings (SiC/glass) to inhibit burn-off over a 1000 hour period is investigated. Bulk protection by conversion of the carbon-matrix into SiC is investigated as a means of short term protection. The results of long and short term high temperature tests are presented. ESA

N91-11826# Tokyo Inst. of Tech., Yokahama (Japan).
FUNCTIONALLY GRADIENT MATERIALS (FGM) ARCHITECTURE: A NEW TYPE OF CERAMIC-METAL ASSEMBLAGE DESIGNED FOR HOT STRUCTURAL COMPONENTS
K. Wakashima, T. Hirano, and M. Niino (National Aerospace Lab., Kakuda, Japan) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 97-102 (For primary document see N91-11812 03-24)
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A ceramic-metal assemblage for use in heat shielding structural components is proposed. The design, manufacture, and testing aspects of the assemblage are discussed. Examples of numerical analysis carried out in the design process are described. The need to extend the analytical framework so as to cover the transient and inelastic thermomechanical response of the Functionally Gradient Materials (FGM) is stressed. The study of environmental conditions in anticipation of real applications as well as continuing effort to construct the design data base are identified as areas where further work is needed. ESA

N91-11827# Nippon Kokan K. K., Kawasaki (Japan). Steel Research Center.
FABRICATION OF THE FUNCTIONALLY GRADIENT MATERIALS (FGM): THE STATE OF THE ART
Akihide Yoshitake, Manabu Tamura, Ichiro Shiota, and Masayuki Niino (National Aerospace Lab., Kakuda, Japan) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 103-107 (For primary document see N91-11812 03-24)
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Functionally Gradient Material in which metal parts change gradually into ceramic parts is discussed. FGM is being developed as a heat resistant material for Japanese spaceplanes. The four main processes, vapor phase, powder metallurgy, spraying and the SHS involved in FGM manufacture are described. The merits and disadvantages of each of these processes and of the FGM produced by the process are reviewed. The thermal and mechanical properties of the FGM produced are measured and reported. ESA

N91-11828# Aerospatiale Aquitaine, Saint-Medard en Jalles (France). Strategic and Space Div.
FIBER-REINFORCED GLASS-CERAMIC MATRIX COMPOSITES: NEW CLASS MATERIALS FOR SPACE APPLICATIONS
J. F. Jamet *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 109-113 (For primary document see N91-11812 03-24)
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A new type of glass and glass/ceramic matrix material is discussed. Potential uses of these fiber reinforced glasses and glass-ceramic matrix composites are reviewed. Their processing, interfaces and characterization are studied. Relationships between the behavior of the material and their microstructure are given special attention. Use of the material in high temperature conditions in space planes, and hot missiles is discussed. The high dimensional stability of the material makes it useful for applications in optical devices and space stations. ESA

N91-11829# British Aerospace Dynamics Group, Bristol (England).
SLIP COEFFICIENTS FOR SHEAR JOINTS: THE EFFECTS OF DYNAMIC LOADING AND SURFACE TREATMENT **c37**
R. J. Baylis *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 117-122 (For primary document see N91-11812 03-24)
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An experimental program of work undertaken to generate data for slip coefficients for shear joints is described. The data is intended for inclusion in the guidelines for threaded fasteners with particular application to space structures. The effects of dynamic loading and surface treatments on aluminum and plastic composites in the shear joint are investigated. Statistical analysis is carried out to provide data for the initial design of shear loaded bolted joints typical of those used in space structures. Alochromed and anodized aluminum show better slip resistance than untreated aluminum. ESA

N91-11830# Societe Europeenne de Propulsion, Vernon (France).
STUDY OF THE EFFECTS OF POST HEAT TREATMENT ON THE RESIDUAL STRESSES IN ELECTRON BEAM WELDS OF TANKS SHELL IN TITANIUM **c39**
D. Baralle, J. Lu, B. Miege, and J. F. Flavenot (Centre Technique des Industries Mecaniques. Senlis, France) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 123-126 (For primary document see N91-11812 03-24)
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A development program for internal stress measurement in the shell Electron Beam (EB) welds of titanium alloy tanks (Ti6Al4V) is outlined. Improvement of the EB post heat treatment is the goal of the program. Two representative pieces are welded. One of them is post heat treated by means of an electron beam, the other is not. Residual stress measurement is carried out on the

two pieces by means of two different methods. An x ray diffraction method is used to determine the surface residual stresses. An incremental hole drilling method is used to measure the through thickness residual stress distribution in the welds. ESA

N91-11831# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (Germany, F.R.). Dept. of Space.
JOINING OF BMI COMPOSITE
U. Glaser and H. Krings *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 127-130 Sponsored by ESA (For primary document see N91-11812 03-24)
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Joining methods to be used on the BMI prepreg system 5250-2/T800 produced by BASF/NARMCO are investigated. Test results of comparable cocured-bonded joints are described and compared. Strap joints are tested at three different temperatures. Cocured specimens manufactured in four different processes are examined and compared with bonded joints glued with HYSOL 9673 film adhesive. Because autoclave time is necessary for bonded joints, cocured parts are limited in size by available autoclave dimensions. ESA

N91-11832# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Dept. of Structure Mechanics.
INSERT TECHNOLOGY: RE-EVALUATION OF THE POTTING PROCEDURE **c27**
U. Rieck and W. Paul *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 131-135 Prepared in cooperation with ERNO Raumfahrttechnik G.m.b.H. (For primary document see N91-11812 03-24)
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Present potting procedure is reviewed with respect to potential sources leading to improper potting. Such improper potting may lead to decreased strength capabilities of the insert elements. Controls for the primary process parameters are established. The potting compound flow behavior is investigated under systematic variation of the previously defined parameters. The results are discussed in view of improving potting procedures. The avoidance of disturbances within the bore hole is concluded to facilitate proper flow of the compound into core cells adjacent to the insert thus causing good coupling and effective load transfer between element and core structure. ESA

N91-11833# Joint Research Centre of the European Communities, Ispra (Italy). Materials Reliability and Performance Div.
MICROSTRUCTURE AND PROPERTIES OF ALUMINIUM ALLOY 7050 ELECTRON BEAM WELDMENTS **c26**
M. Vedani, F. DosSantosMarques, G. Tuberga, G. Piatti, and V. Wagner (Aeronautica Macchi S.p.A., Varese, Italy) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 137-142 (For primary document see N91-11812 03-24)
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Quaternary (Al-Zn-Mg-Cu) 7050 alloy electron beam welds are submitted to microhardness tests and tensile tests on miniature specimens. The material strength in the individual regions of the welded joint (parent metal, heat affected zone, partially melted zone and weld metal) is assessed. Microstructural analysis of the welded joints is carried out. The joints reveal a wide variability of properties mainly related to different structural morphologies and to the thermo-mechanical welding cycle to which the material regions are submitted. ESA

N91-11834# Aeritalia S.p.A., Pomigliano D'Arco (Italy). Transport Aircraft Group.
DETECTION OF IMPACT DAMAGE IN COMPOSITES BY HOLOGRAPHIC INTERFEROMETRY **c38**
G. Cavaccini, P. Ferraro, and C. Sabatino *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 145-149 (For primary document see N91-11812 03-24)
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Holographic interferometry is used as a nondestructive testing tool to evaluate damage in composite structures. Preliminary tests performed on an impacted thermoplastic panel are described. The goal of the tests is to determine the relationship between impacted area extension and impact energy. An argon laser system used to produce holograms and compute the extension of damage areas is described. Image processing software on eight bits acquired images used in the analysis is presented. Limitations of the system and improvements to be made are identified. ESA

N91-11835# Aeritalia S.p.A., Pomigliano D'Arco (Italy).
HOLOGRAPHIC INTERFEROMETRY AS AN INSPECTION TECHNIQUE ON AEROSPACE COMPOSITE STRUCTURE **c38**
P. Ferraro, L. Pagnotta, A. Poggialini (Calabria Univ., Arcavacta di Rende, Italy), and C. Sabatino *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 151-155 (For primary document see N91-11812 03-24)
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Application of holographic interferometry to the evaluation of the integrity of sandwich structures is described. Capabilities offered by pressure stressing techniques are investigated. Different operating procedures are tested on a specimen containing a disbond intentionally produced during the manufacturing cycle. It is found that application of temporary internal pressure could be used to reveal the defect. The approach can be applied in all cases where materials making up the sandwich are porous. ESA

N91-11836# Norske Veritas, Oslo.
IN ORBIT IN-SERVICE INSPECTION **c18**
O. Forli *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 157-161 (For primary document see N91-11812 03-24)
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In service inspection systems to reveal possible in orbit degradation or damage are discussed. A review of projected inspection needs and the inspection tools that need to be developed for the Columbus space laboratory is presented. Various projected nondestructive testing systems are described. Meteoroid and debris impact as well as overloads due to operation and human activities are identified as being the most significant sources of degradation. The Columbus in service inspection system is to be based on a global acoustic impact monitoring system and local eddy current or ultrasonic examination to further characterize impact damage and reveal possible cracks. ESA

N91-11837# Sira Inst. Ltd., Chislehurst (England).
NDT OF CFRP STRUCTURES: EVALUATION OF A NEW METHOD **c38**
J. M. B. Webber *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 163-169 (For primary document see N91-11812 03-24)
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Research was aimed at identifying the potential for SPATE and related techniques in full field stress and nondestructive test (NDT) analysis and establishing parameters of methods and procedures that may be applied to composites, in particular Carbon Fiber Reinforced Plastics (CFRP). The SPATE instrument detects the cyclic temperature changes induced in a test object by the application of cyclic load to produce stress maps over selected areas of the structure. The theoretical and experimental background of thermoelastic stress analysis is described and a number of recent applications of stress and NDT analysis in composites are reported. Results of an experimental program to assess the technique for inspection of aerospace composite components, using well defined samples, are described. ESA

N91-11838# Aerospatiale Aquitaine, Saint-Medard en Jalles (France). Strategic and Space Div.
NONDESTRUCTIVE INSPECTION FOR CARBON-CARBON WITH ADAPTED COATING FOR OXIDATION **c38**
P. Plotard and C. LeFloch *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 171-179 (For primary document see N91-11812 03-24)
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Nondestructive testing of the carbon-carbon material to be used in the nose cap and leading edges of the Hermes Space Plane is

discussed. Hermes is designed to withstand 30 subsequent reentries. The importance of nondestructive testing as a means of insuring such reliability requirements during the manufacture and life of the vehicles is stressed. Quantification of the functional characteristics of the material (coating thickness and critical defects such as delaminations, voids, decohesions, oxidation cavities) is given particular attention. Nondestructive methods developed for measuring such parameters are described. ESA

N91-11839# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
INFRARED THERMOGRAPHY DEVELOPMENT FOR MATERIAL EVALUATION OF HERMES SPACE PLANE COMPONENTS **c38**
Herve Tretout, Jean-Yves Marin, and Rene DeMol *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 181-184 (For primary document see N91-11812 03-24)
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The use of infrared thermography as a nondestructive means of inspecting ceramic material parts is described. Its use in inspecting fiber reinforced composites is discussed. Special application of the technology to the inspection of ceramic materials used in the manufacture of the Hermes Space Plane is outlined. Surface analysis, line analysis and comparison of surface and line analysis are discussed. Advantages of infrared thermography using a high frame rate thermal analyzer, image processing and artificial intelligence over traditional thermally stimulated infrared thermography are described. ESA

N91-11840# Amoco Performance Products, Inc., Bound Brrok, NJ.
ADVANCED PITCH FIBRE PREPREGS FOR SPACE APPLICATIONS
P. W. Manders and F. C. Robertson (Amoco Chemical UK Ltd., Gerrards Cross, England) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 187-192 (For primary document see N91-11812 03-24)
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Pitch fiber reinforced matrices (thermosets, thermoplastics, and metals) are studied in terms of possible use for space applications. The relationship between fiber microscopic properties and final laminate performance is discussed. Several new products developed to meet the material requirements for space applications are described. These include an ultrathin thermoset prepreg, a thermoplastic prepreg, metal matrix composites reinforced with pitch fiber and ultrahigh modulus fiber. Weight savings using these products are predicted to offer potential for extending the lifetime of satellites and increasing the payload weight. ESA

N91-11841# Societe Nationale de Construction Aeronautique, Gosselies (Belgium).
SIMULATION OF PHYSICO-CHEMICAL PROPERTIES DURING THE CURE OF THERMOSET SYSTEMS **c27**
B. Poulaert, J.-L. Coppee, P. Landuyt, and J.-M. Liegeois (Liege Univ., Belgium) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 193-197 (For primary document see N91-11812 03-24)
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A deterministic model used for predicting the physico-chemical properties of epoxy resins during the cure is described. The model is based on the determination of kinetic parameters of three main reactions, and diffusional parameters required for high levels of conversion. A law giving the evolution of the glass transition temperature as a function of the extent of conversion is defined. The viscosity is calculated using another law. Applications to model compounds and to commercial resins are presented. Use of the model in studying the physico-chemical behavior of the resin during the entire cure cycle is discussed. ESA

N91-11842# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
PMR 15T: PRELIMINARY CHARACTERIZATION FOR THE MECHANICAL PROPERTIES AND MANUFACTURING **c27**
Michel David *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 199-205 (For primary document see N91-11812 03-24)
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A new version of the PMR 15 polyimide resin named PMR 15T is described. The physico-chemical properties of the prepreg are investigated. The stages involved in the curing cycle are defined. Preliminary mechanical characterization is carried out. A stiffened panel one meter square with single curvature is manufactured. The resin is considered for use in the Hermes Manned Space Plane program. The main results obtained during testing of PMR 15T are presented. ESA

N91-11843# Surrey Univ., Guildford (England). Dept. of Civil Engineering.
HIGH-TECHNOLOGY CARBON-FIBRE/POLYETHERSULPHONE COMPOSITE FOR SPACE APPLICATIONS
A. Thorne and L. Hollaway *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 207-211 (For primary document see N91-11812 03-24)
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A large skeletal structure to be used in making antenna reflectors for land mobile communications systems is described. The structure could also be used in making space platforms up to 300 m in diameter. The land based antenna reflectors would be limited to 50 m in diameter. The skeletal system in the form of a tetrahedral truss is described. Results of solar simulation tests in which polyethersulphone composite samples were tested between minus 150 and 40 C under high vacuum are described. ESA

N91-11844# Westland Aerostructures Ltd., East Cowes (England).
THERMOPLASTICS DESIGN DEVELOPMENT CONSIDERATIONS FOR CRYOGENIC TANKS **c27**
Jim Scragg *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 213-214 (For primary document see N91-11812 03-24)
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The use of fiber reinforced resin matrix composites in space structures is discussed. The use of such composites in making the cryogenic tanks containing LOX (Liquid Oxygen) and LH (Liquid Hydrogen) propellants in launch vehicles is investigated. Their use in satellite positioning is also discussed. The effects of cryogenic temperatures on the mechanical properties of the APC2 composite material successfully used in making such tanks are investigated. Two series of tests investigating the tensile strength following different preconditioning regimes and fluid containment efficiency of the tanks are described. The test results indicate that APC2 retains its tensile properties at cryogenic temperatures. ESA

N91-11845# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.).
STATUS OF ESA'S COMPOSITES DESIGN HANDBOOK FOR SPACE STRUCTURE APPLICATIONS
J. Bolz *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 217-220 Prepared in cooperation with ERNO Raumfahrttechnik G.m.b.H. (For primary document see N91-11812 03-24)
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The status of the Composites Design Handbook (CDH) in 1986 is discussed. General revisions and modifications based on the comments received from ESA's Advanced Structural Materials Exchange Group are outlined. New information on various topics which were considered relevant for the design of composite structures is described. A short survey of the updates and extensions of the CDH contents is presented. Future activities are expected to concentrate on reinforced ceramics and carbon-carbon materials. ESA

N91-11846# Fulmer Research Inst. Ltd., Stoke Poges (England).
INTRODUCING AN ADHESIVE BONDING HANDBOOK FOR ADVANCED STRUCTURAL MATERIALS **c27**
Josephine Wilson *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 221-224 (For primary document see N91-11812 03-24)
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The handbook has the objective of providing an introductory but technical guide to the topic of adhesive bonding advanced structural materials used in space hardware. The handbook is divided into sections on materials, design, manufacture, inspection and testing. Case studies illustrating how the whole process is applied in practice are presented. Bonded repairs, one specific application of adhesive bonding, is described. Emphasis is placed on the need for a fully integrated design process to be followed for adhesive bonding applications. ESA

N91-11847# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.).
MULTIWALL THERMAL PROTECTION SYSTEM ENGINEERING ASPECTS **c18**
H. Grallert and K. Keller (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 227-231 (For primary document see N91-11812 03-24)
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Use of the metallic multiwall concept in thermal protection of hypersonic winged spacecraft is investigated. Examples of different thermal loads on the Advanced Space Transportation System upper and lower stages are given. The main requirements for related Thermal Protection System (TPS) are identified. Design driving requirements are discussed and critically evaluated. Critical design areas are identified and briefly described by means of examples. A test philosophy relying on laboratory tests as well as on static and dynamic full panel testing is described. ESA

N91-11848# Societe Europeenne de Propulsion, Saint-Medard-en-Jalles (France).
DEVELOPMENT OF C/SIC LARGE PARTS TECHNOLOGY FOR AEROSPACE PLANE THERMAL STRUCTURES **c18**
Alain Lacombe, Jean-Michel Rouges, and Pierre Taveau *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 233-239 (For primary document see N91-11812 03-24)
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Technologies developed to build large C/SiC parts within the Hermes program are described. Textile special processes for quasi three dimensional preforms are discussed. Silicon carbide deposition along large parts is outlined. Anti-oxidation protection of the material is described. A wing box for synthesizing the capabilities of the technology is manufactured. Advanced facilities developed to meet the manufacturing requirements of such large C/SiC thermostructures are described. ESA

N91-11849# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Central Labs.
DEVELOPMENT OF FABRICATION METHODS FOR METALLIC MULTILAYER STRUCTURES **c26**
W. Keinath and P.-J. Winkler *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 241-246 (For primary document see N91-11812 03-24)
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Manufacturing technologies for multilayer systems in a wide range of metals are described. High strength metals such as Al, Ti, Ni, Co, and Fe-base alloys are taken into consideration. Manufacturing methods such as deep drawing, roll bonding and superplastic forming are described. Joining techniques such as diffusion bonding and diffusion brazing are discussed. Various parts made from sheets and foils are presented. The importance of metallic materials in the development of hypersonic and transatmospheric vehicles is stressed. ESA

N91-11850# Aerospatiale Aquitaine, Saint-Medard en Jalles (France). Strategic and Space Div.
NEW DEVELOPMENTS IN COMPOSITES FOR SPACE APPLICATIONS
J. F. Jamet and D. Cabanel *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 247-253 (For primary document see N91-11812 03-24)
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Experience and capabilities in the area of nonmetallic composites for strategic and space applications are described. Special technologies developed for resin formulation and tow impregnation are outlined. High capacity winding machines, expert systems for the optimization of structural joining and radio-curing of large structures is described. Work carried out in the areas of carbon-carbon composites and ceramic composites is summarized. Characterization procedures, nondestructive testing and manufacturing control are discussed. ESA

N91-11851# British Aerospace Public Ltd. Co., Stevenage (England).
FILAMENT WINDING OF SATELLITE STRUCTURES
G. M. Teare *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 257-260 (For primary document see N91-11812 03-24)
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A filament winding method successfully applied to the production of an element of primary satellite structure is described. A thrust cylinder, of sandwich construction with an aluminum honeycomb core is wet wound using a high modulus carbon fiber impregnated with an amine hardening epoxy resin. Low angle fiber placement is used to provide high axial stiffness. Faceskins quality compares favorably with autoclave cured material. Manufacturing costs and cyclinder production time are reduced with marginal reduction in structural efficiency. ESA

N91-11852# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (Germany, F.R.). Dept. of Space.
APPLICATION OF ADVANCED STRUCTURAL MATERIALS IN PROPELLANT TANKS AND PRESSURE VESSELS
R. Forster *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 261-266 (For primary document see N91-11812 03-24)
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Different construction materials used in the manufacture of pressure vessels are analyzed. The material properties, design considerations and manufacturing aspects for tanks used in storing solid and liquid propellants as well as high pressure gas are identified. Design requirements such as light weight, propellant compatibility, gas leak tightness and cost considerations for different pressure vessel construction materials and technologies are analyzed. Typical applications of all-composite, all-metal and prestressed composite vessels are presented. ESA

N91-11853# Aerospatiale Aquitaine, Saint-Medard en Jalles (France). Strategic and Space Div.
WOUND HELIUM PRESSURANT TANK DEVELOPMENT FOR 2ND STAGE OF ARIANE 4 LAUNCHER **c15**
Y. Valy and P. Coquet *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 267-269 Previously announced in IAA as A90-42134 (For primary document see N91-11812 03-24)
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The manufacture of a wound pressurant tank for the second stage of the Ariane 4 launcher is described. The goal of the manufacturing process is to save 26 kg per tank resulting in an overall savings of 78 kg for the second stage. This is equivalent to an extra mass payload of about 20 kg. The technical requirements of the tank are described. Development requirements and approach are outlined. Qualification standards of the design and qualification tests are described. Tank behavior is checked using acoustic emission and ultrasonic inspection. ESA

N91-11854# FDO Technische Adviseurs B.V. (Netherlands).
RESULTS OF POST FIRING EXAMINATIONS OF IGNITER NOZZLES OF THE VULCAIN ENGINE **c20**
J. E. Buter and G. K. Troost (Stork Product Engineering, Amsterdam, Netherlands) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 273-276 (For primary document see N91-11812 03-24)
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A search for alternative nozzle materials for the Vulcain engine is described. A number of materials are tested. Modifications of the original design appear to generate as good a solution as other refractory materials. The presence of aluminum in the propellant is suggested as one of the major reasons for initial damage to the nozzles. Since no reasonable design modification is found, aluminum is abandoned. Final tests with the new formula propellant confirm the detrimental effect of aluminum. ESA

N91-11855# Societe Europeenne de Propulsion, Saint-Medard-en-Jalles (France). Div. Propulsion a Liquides et Espace.
CMC MATERIALS FOR A HIGH PERFORMANCE 20 N THRUSTER **c20**
A. Mathieu and E. Soler *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 277-282 (For primary document see N91-11812 03-24)
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Ceramic Matrix Composites (CMC) with fiber reinforcement developed for use in making bipropellant thrusters are described. A 20 N thruster developed for use on Hermes and in satellite attitude and orbit control is discussed. The design of the thruster is based on five years experience in manufacturing and testing bipropellant thrusters equipped with CMC combustion chambers and nozzles. Firing test results for the thrusters are outlined. Photographs of combustion chambers and nozzles are presented for thrusters of different thrust levels. ESA

N91-11856# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart (Germany, F.R.). Inst. for Structures and Design.
DEVELOPMENT AND REAL-TEST OF A RAMJET NOZZLE MADE OF LIQUID-SILICON-INFILTRATED C/SiC **c20**
H. Hald, P. Szasz, and K. Dittrich *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 283-289 (For primary document see N91-11812 03-24)
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A ramjet nozzle with an integrated secondary combustion chamber is produced using C/SiC material. The mechanical properties of the material are evaluated by means of equivalent C/SiC tubes tested in a hydraulic pressure test set up at ambient temperature. Material pseudo-plasticity is observed which provides a certain damage tolerance. The nozzle, 250 mm long, 75 mm in mean diameter with a mass of 220 g is tested at an experimental ramjet test facility to its thermo-mechanical limits. The applicability of C/SiC material for highly thermomechanically loaded structures is confirmed. A limited lifetime in oxidative atmospheres is however demonstrated. ESA

N91-11857# BHP Labs. Ltd., Limerick (Ireland).
ALUMINIUM-LITHIUM ALLOYS: A REVIEW AND ASSESSMENT **c26**
B. OBrien and A. Pradier (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 293-300 (For primary document see N91-11812 03-24)
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The development of Al-Li alloys in recent years is reviewed. The future potential of the alloys is assessed. The mechanical properties of the alloys compare reasonably well with conventional alloys but problems with ductility and toughness of thick products remain. General corrosion behavior is shown to be good, but localized corrosion, particularly stress corrosion is poor. Manufacture and processing aspects are reviewed. Applications of Al-Li alloys in satellites are reviewed. It is concluded that Al-Li alloys will be used on European spacecraft within 3 to 5 years. ESA

N91-11858# Raufoss Ammunisjonsfabrikker (Norway).
OXIDE DISPERSION STRENGTHENED ALUMINIUM: PROPERTIES AND USE **c26**
Einar Hellum and Michael J. Luton (Exxon Research and Engineering Co., Annandale, NJ.) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 301-305 (For primary document see N91-11812 03-24)
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Oxide Dispersion Strengthened aluminum (ODS) is produced by mechanical alloying in a high energy ball mill in a liquid nitrogen beth. The material produced by this technique contains aluminum as a matrix material reinforced with oxy-nitride particles between 2 and 10 mm in size. The material can be extruded into bars, tubes, or rolled into sheets. Applications in aerospace materials where ODS can compete with titanium in the 300 to 450 C temperature interval are discussed. The use of ODS as skin material in sandwich structures, plate materials or heat exposed motor parts is outlined. ESA

N91-11859# Raufoss Ammunisjonsfabrikker (Norway).
CARBON FIBRE REINFORCED ALUMINIUM: MANUFACTURING AND PROPERTIES **c26**
Ragnar Holthe and Kolstein Asboll *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 307-312 Sponsored by Norwegian Space Agency (For primary document see N91-11812 03-24)
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Carbon Fiber Reinforced Aluminum (CFRAl) made by squeeze casting of hand laid up or filament wound preforms is described. Samples with unidirectional reinforcement are tested in both tensile and flexural modes. Near rule of mixture strength and near zero thermal expansion are obtained. Combination of filament winding and squeeze casting is found to be a suitable process for manufacturing high performance CFRAl struts. Properties reported in the literature for CFRAl materials and the effects of hybrid fiber techniques are reviewed. ESA

N91-11860# Technische Univ., Delft (Netherlands). Dept. of Structures and Materials.
NEW DEVELOPMENTS IN FIBRE METAL LAMINATES (ARALL) **c26**
C. A. J. R. Vermeeren, L. B. Vogelesang, and J. W. Gunnink *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 313-317 (For primary document see N91-11812 03-24)
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The structure of ARALL materials is described. Built of alternating thin metal alloy sheets and unidirectional or crossply layers of preimpregnated aramid, R-glass or carbon fibers, the ARALL materials offer outstanding mechanical, fatigue and fracture toughness properties. The applications of different types of ARALL sheets to aircraft structures for airbuses A330 and A340 are discussed. The use of thermoplastic adhesive systems is investigated. Such systems offer promising high temperature, mechanical and fatigue properties in combination with creep and temperature resistant titanium alloy sheets. ESA

N91-11861# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
SHIELDING AGAINST ORBITAL DEBRIS: A CHALLENGING PROBLEM **c18**
Michel Lambert *In its* Space Applications of Advanced Structural Materials Jun. 1990 p 319-328 (For primary document see N91-11812 03-24)
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The physics of hypervelocity impacts is reviewed with special application to impact of space debris on orbiting spacecraft. The

potential effects on different spacecraft structures are described. The status of experimental and theoretical work for the Columbus Space Station is reported in detail. A strategy for continued investigation of shielding performance is outlined. Ways in which the weight of shielding elements can be decreased are investigated. The use of composite materials for shielding is discussed. ESA

N91-11862# Tohoku Univ., Sendai (Japan). Research Inst. for Fracture Technology.
STANDARDIZATION PROGRAM FOR FRACTURE EVALUATION OF FUNCTIONALLY GRADIENT MATERIAL (FGM) OF VERY HIGH TEMPERATURE APPLICATION
H. Takahashi, T. Hashida, and M. Niino (National Aerospace Lab., Kakuda, Japan) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 331-337 Sponsored by Japanese Science and Technology Agency (For primary document see N91-11812 03-24)
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Several Functionally Gradient Materials (FGM) 30 mm in diameter and 3 to 5 mm thick are described. Test results for fracture properties such as strength and thermal shock resistance are presented. Experimental investigation into miniaturized specimen test procedures are described. A modified small punch method developed to measure the elastic constant and fracture strength of each constitutional microstructure of FGM is outlined. Results of laser radiation thermal shock tests on both conventional ceramic materials and plasma-sprayed FGM are described. ESA

N91-11863# National Aerospace Lab., Kakuda (Japan).
EVALUATION OF THERMOMECHANICAL PROPERTIES OF FUNCTIONALLY GRADIENT MATERIAL UNDER HIGH TEMPERATURE DIFFERENCE
A. Kumakawa, S. Maeda, M. Sasaki, M. Niino, A. Sakamoto, M. Sasaki, and T. Hirai (Tohoku Univ., Sendai, Japan) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 339-344 (For primary document see N91-11812 03-24)
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The thermal resistance and thermal fatigue properties of Functionally Gradient Materials (FGM) are measured. The effect of steep temperature gradients without any oxidation, corrosion or erosion effects is studied. A test apparatus developed for carrying out such tests is described. Tests results indicate that FGM would have the potential of relaxing the thermal stress caused by a mismatch of thermal expansion under a heavy heat load. Comparisons of FGM specimens with conventional materials are described. The FGM show higher thermal resistance and longer thermal fatigue life than conventional materials. ESA

N91-11864# Katholieke Univ. te Leuven (Belgium). Dept. of Metallurgy and Materials Engineering.
THERMAL BONDING OF THERMOPLASTIC COMPOSITES: INFLUENCE OF MATRIX AND INTERLAYER ON THE WELD FRACTURE TOUGHNESS **c27**
B. Goffaux and I. Verpoest *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 345-350 Sponsored by Belgian Inst. for Scientific Research in Industry and Agriculture (For primary document see N91-11812 03-24)
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The various factors influencing the toughness of welded joints in thermoplastic composites are investigated. Three factors are identified as having a positive influence on weld quality. The use of an interlayer which creates fiber migration in the joint zone is described. The importance of the amorphous state of the surface of the composite before welding is stressed. The role played by the state of the joint after welding is outlined. It should be also amorphous for best results. The main advantage of the hybrid welding technique is that the welding temperature can be kept lower than the lamination temperature. ESA

N91-11865# Aerospatiale Aquitaine, Saint-Medard en Jalles (France). Strategic and Space Div.
HOW TO KNOW CMC...
F. Albugues and P. Peres *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 351-362 (For primary document see N91-11812 03-24)
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The factors involved in gaining a clear understanding of Ceramic Matrix Composite (CMC) are described. The various research partners within France working within this area are identified. Mechanical test validity on test samples are described. Fracture behavior modeling is discussed. Mechanical tests related to microstructure are outlined. Mathematical modeling of elementary structures is discussed. Precise characterization over a total temperature, environment and cycling range is investigated. Analysis and cartography of elementary defects and their evolution during nondestructive testing is outlined. ESA

N91-11866# Politecnico di Torino (Italy). Dept. of Aerospace Engineering.
BUCKLING OF LAMINATED CYLINDRICAL PLATES INCLUDING EFFECTS OF SHEAR DEFORMATION **c39**
G. Romeo, C. Alonso, and A. Pennavaria *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 365-370 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

An analytical solution for the buckling of anisotropic cylindrical plates under biaxial compression and shear loads is presented. Linear equations for laminated cylindrical shells, Donnell-type equations, are used in conjunction with Galerkin's method to determine critical buckling loads. Results obtained indicate that significant nonconservative errors can occur in buckling predictions in comparison with the orthotropic solution. Stacking sequence and curvature radius are shown to affect the buckling loads. Shear deformation effects on the buckling loads are seen to become more pronounced as the ratio of the principal moduli and the number of layers increase. ESA

N91-11867# Fokker B.V., Amsterdam (Netherlands).
A SIMPLIFIED METHOD TO ESTIMATE COMPRESSION ALLOWABLES FOR COMPOSITE STIFFENED PANELS **c39**
J. H. vanderSloot *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 371-379 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

A simplified method for computing the estimated allowable compression load of stiffened composite panels is presented. It is developed from one available for aluminum alloys panels and specifically tailored for the analysis of composite panels. Critical loads for panels with reduced stiffness can be calculated using this method. The reduced stiffnesses are derived from an analysis of postbuckling behavior of typical panel elements. Computational results for panels of practical configurations are reported and correlated with other solutions or test results. ESA

N91-11868# Fokker B.V., Amsterdam (Netherlands).
THE INFLUENCE OF MATERIAL PROPERTIES ON DESIGN VALIDITY AND MARGINS **c39**
M. P. Nieuwenhuizen *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 381-391 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

Ways to optimize design validity are outlined. Uncoupling of research on materials technology and product design activities are called for. The advantages of having handbooks applicable to standardized materials made readily available to users is stressed. Applied safety factors for a project are based on experience and the ratio of ultimate versus yield stress of the material. The factors influencing the safety of ductile and brittle materials are discussed. The importance of improving the knowledge of such safety behavior in nonhomogeneous polymer materials is stressed. ESA

N91-11869# Fokker B.V., Amsterdam (Netherlands).
DETERMINATION OF MATERIAL DESIGN ALLOWABLES **c39**
C. A. Hermens *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 393-395 (For primary document see

N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

The requirements prescribed by the Joint Airworthiness Requirements (JAR) are discussed. Because the objectives of weight reduction conflict with safety requirements, careful examination of the so-called B value is carried out. The statistical methods used in establishing B values are described. Determination for both metals and carbon fiber materials is described. The question of the safety required by design allowables is discussed. The importance of sample selection in safety testing is pointed out. ESA

N91-11870# British Aerospace Public Ltd. Co., Stevenage (England).
COST OPTIMISATION OF LOAD CARRYING STRUCTURES **c18**
B. A. Reid and A. Pradier (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 397-402 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

Research on identifying cost drivers and establishing guidelines for optimizing the cost of satellite structures is described. Specifications envelope, qualification philosophy, and standardization and methodology are identified as critical cost drivers. To assess the impact of material selection on achievement of the mass budget, alternative minimum mass and minimum cost design philosophies are applied to a range of materials. It is found that applying minimum mass philosophy to each material, up its performance limit is the most cost effective. ESA

N91-11871# Fulmer Research Inst. Ltd., Stoke Poges (England).
TESTING AND INTEGRITY OF THERMOSTRUCTURAL CERAMIC MATRIX COMPOSITES
D. P. Bashford and R. Raynal (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 405-409 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

The properties of continuous fiber ceramic matrix composites are investigated. Very high temperatures, around 1600 C, are needed to characterize these materials, in both neutral and oxidizing atmospheres. The key mechanical characteristics relating to tensile, compressive, shear and flexural loading modes are discussed. The factors to be considered before developing test methods are identified. These include representative test specimens, machining, load introduction, strain measurement and failure characteristics. The significance of fracture characteristics is assessed in relation to design allowables. ESA

N91-11872# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
MATERIALS FOR HERMES HOT STRUCTURAL PARTS: REQUIREMENTS AND TESTING
Gerard Bernhart *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 411-417 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

The general logic of a material testing program designed to test the Hermes Thermal Protection System (TPS) is described. Mission specifications during launch, orbital mission and reentry are taken into consideration in the program. Two types of materials, carbon-carbon and carbon-silicon carbide composites are selected as candidates for the TPS system. The specifications of each of these materials are presented with respect to the nominal design. Definition of antioxidation processes is discussed. Optimal material development is outlined. ESA

N91-11873# Aerospatiale Aquitaine, Saint-Medard en Jalles (France). Strategic and Space Div.
SIMOUN: NEW TEST METHODS FOR DEVELOPMENT WORK ON THE HERMES THERMAL PROTECTION SYSTEMS [SIMOUN: UN NOUVEAU MOYEN D'ESSAIS POUR LE DEVELOPPEMENT DES PROTECTIONS THERMIQUES D'HERMES] **c18**
P. Charpentier and R. Leroux *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 419-425 In FRENCH (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

The SIMOUN test apparatus is described. It is designed for testing the thermal protection systems developed for the Hermes Manned Space Plane. It develops a flow of extremely hot air by means of a plasma generator. The potential uses and various configurations possible using the system are described. Diagrams and photographs of the test apparatus are presented. The various parameters that can be simulated using SIMOUN are described. The operational framework and organization of test apparatus operation are described. ESA

N91-11874# United Kingdom Atomic Energy Authority, Harwell (England). Dept. of Advanced Engineering Materials.
THE CURRENT STATUS AND FUTURE PROSPECTS OF SMART COMPOSITES
R. Davidson *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 429-436 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

Smart or intelligent materials, modeled on biological systems with sensors acting as a nervous system are discussed. Actuators act as muscles in these materials and real time computers act as a brain to interpret signals and control the system. Smart materials concepts are most easily applied in structural composite materials where appropriate sensors and actuators can be embedded into the structure during manufacture. The concepts involved in this area are reviewed. What is currently possible and will be possible in the future through emerging technology is discussed. ESA

N91-11875# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
MULTIFUNCTIONAL STRUCTURES FOR AEROSPACE APPLICATIONS
Kay W. Dittrich *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 437-441 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

Multifunction or smart structures are discussed. Such structures are defined as structures incorporating additional functions besides the function of load carrying. The additional functions may be sensing, communication data processing or shape changing. To achieve this multifunctionality, additional elements must be embedded into the structure. Ways in which smart structures may enhance the performance and reduce the weight of space structures are discussed. Incorporation of antennas, sensors, electronics, processors, etc., into spacecraft construction materials is discussed. ESA

N91-11876# Westland Aerostructures Ltd., East Cowes (England).
DEVELOPMENT OF INTELLIGENT STRUCTURES
Jim Scragg *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 443-444 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

The development of structures within composite materials used to provide a quiet vibration free mounting for sensitive equipment is described. Fiber optic sensors embedded in composite thermoset materials can measure vibration. Advanced thermoplastic composites offer better environmental characteristics. Ways to incorporate vibration free structures into a carbon fiber reinforced thermoplastic matrix are discussed. Development of an actuation system to counteract vibration is described. Difficulties involved in

embedding fiber optic sensors into thermoplastic composites which are processed at much higher temperatures than thermosets are discussed. ESA

N91-11877# Bundesanstalt fuer Materialpruefung, Berlin (Germany, F.R.).
X RAY DIFFRACTION SCANNING MICROSCOPY: A NEW METHOD OF NON-DESTRUCTIVE CHARACTERIZATION OF INHOMOGENEOUS MATERIALS **c38**
M. P. Hentschel, A. Lange, and W. Harbich *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 447-450 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

The uses of x ray diffraction scanning microscopy in gaining greater insight into the microstructure of opaque materials are described. Computer section images of the layered structures of thick carbon fiber reinforced plastic and carbón fiber reinforced ceramic samples are shown. The method can be applied to condensed matter of any kind. The technique can be considered as an expansion of classical x ray tomography. Use of the method is recommended for new material development rather than large structure inspection. ESA

N91-11878# Ballistic Research Labs., Aberdeen Proving Ground, MD.
CURE SIMULATION OF THICK THERMOSETTING COMPOSITES Final Report, Jan. 1989 - Apr. 1990
Travis A. Bogetti and John W. Gillespie, Jr. (Delaware Univ., Newark.) Jul. 1990 65 p
(DA Proj. 1L1-662618-AH-80)
(AD-A224885; BRL-TR-3121) Avail: NTIS HC/MF A04 CSCL 13/8

The potential for enhanced performance characteristics of composite materials over conventional metals, such as high strength-to-weight ratio, high stiffness, corrosion resistance and low radar signature, makes them extremely attractive for a wide range of military applications. The curing process of thick-section thermosetting composites is critical to the quality and in-service performance of the finished component. An investigation into the 2-D cure simulation of thick thermosetting composites is presented. Temperature and degree of cure distributions within typical glass/polyester and graphite/epoxy structural elements of arbitrary cross-section (ply-drop and angle bend) are analyzed to provide insight into the non-uniform curing process unique to thick-sections. An incremental, transient finite difference solution scheme is implemented to solve the pertinent governing equations and boundary conditions. Correlation between experimentally measured and predicted through-the-thickness temperature profiles in glass/polyester laminates are presented for various arbitrary temperature cure cycle histories. Spatial gradients in degree of cure are shown to be strongly dependent on part geometry, thermal anisotropy, cure kinetics and the temperature cure cycle. These spatial gradients directly influence the quality and in-service performance of the finished component by inducing warpage and residual stress during the curing process. GRA

N91-11879# Colorado School of Mines, Golden. Center for Welding and Joining Research.
FUNDAMENTAL CONCEPTS OF WETTABILITY AND INTERFACIAL BOND STRENGTH IN ALUMINUM MATRIX, SiC-REINFORCED COMPOSITES Annual Report
Glen R. Edwards and David L. Olson Jul. 1990 52 p
(Contract N00014-88-K-0500)
(AD-A225158; CSM-MT-CWR-090-012) Avail: NTIS HC/MF A04 CSCL 07/4

Research accomplishments include: Surface Energy Measurement - Differential optical reflectance was used to measure the optical transitions in aluminum and its alloys. The semi-empirical correlation developed earlier was used to calculate the surface energy from the measured transition energies. Predicted surface energies, using the model, were in close agreement with experimentally determined surface energies found in the literature. Wettability Predictions - Wettability studies are based on surface tension measurements from the capillary rise experiment. A mechanism, assuming a defect-rich oxide interlayer at the interface, was proposed to explain the non-wetting behavior of the Al/SiC system. Interfacial Bond Energies - The measured surface energies were used to predict the interfacial bond energies using a work of decohesion model. Punch shear tests were used to make relative determinations of bond strengths for several aluminum alloy/SiC systems. The predicted bond energy trends correlated well with the observed bond strengths. GRA

N91-11880# Delaware Univ., Newark. Center for Composite Materials
DESIGNING COMPOSITE STRUCTURES FOR LOW-VELOCITY IMPACT M.S. Thesis
Timothy Clark Lindsay Aug. 1990 353 p
(AD-A225217) Avail: NTIS HC/MF A16 CSCL 11/4

This thesis presents a methodology and set of tools which the designer can use to improve the resistance of composite structures to low-velocity impacts typical of those experienced in the maintenance, handling, service, and manufacturing of composites, typically termed tool drops. The author has investigated the role of simple analysis and experimental techniques which may be used in the early stages of concept evaluation to provide design-decision support for impact resistant concepts. Identifying the most important customer needs and related design criteria through the application of a coherent, cohesive, and comprehensive design methodology is the first step in a successful design, and insuring that these customer needs are translated through the design, engineering, and manufacture of the product is the essence of design. The author has developed a comprehensive impact design methodology which is contextual, i.e., it is presented in the context of all other design criteria. Instrumented impact testing has been used to identify the incipient damage load in typical unidirectional carbon fiber thermoset and thermoplastic matrix composite coupons subjected to low-velocity impacts. Results have been correlated with static load-deflection response of equivalent coupons in a unique test setup using the same apparatus and then correlated with a finite element analysis of the test specimens. GRA

N91-11881# Dayton Univ., OH.
COMPOSITES SUPPORTABILITY RAPID TEST AND EVALUATION Final Technical Report, Oct. 1986 - Feb. 1990
D. R. Askins, R. Kuhbander, S. Saliba, C. Griffen, and G. W. Lawless May 1990 167 p
(Contract F33615-86-C-5031)
(AD-A225243; UDR-TR-90-24; WRDC-TR-90-4035) Avail: NTIS HC/MF A08 CSCL 11/1

Materials investigations were conducted in the general areas of adhesive bonding, composite materials, aircraft transparencies, and elastomeric seals. These studies were oriented towards characterization of new materials and processes, development of repair techniques, development of new processing techniques, and solution of current operational problems involving materials and processing. Some qualification testing was carried out on new materials. Studies involved the characterization of inorganic and water-based primers for adhesive bonding, adhesive and resins for aircraft repair, novel surface preparation procedures for aluminum and composite adherends, high temperature adhesives, bonding of aluminum castings, composite paint removal techniques, techniques to prepare thermoplastic prepreg, use of induction heating to cure composites, honeycomb repair procedures, evaluation of heat lamps for curing of composite repair patches, assessment of resin transfer molding for filament wound structure, studies of battle-damage-repair techniques for aircraft transparencies, and determination of aircraft fuel and lubricating oil compatibility with elastometic seal materials. GRA

N91-11882# McDonnell-Douglas Research Labs., Saint Louis, MO.
NUCLEAR MAGNETIC RESONANCE NONDESTRUCTIVE EVALUATION OF COMPOSITE MATERIALS Final Technical Report, 19 Sep. 1987 - 19 Jun. 1989

Arthur C. Lind and Charles G. Fry 9 Apr. 1990 80 p
(Contract F33615-87-C-5247)
(AD-A225268; MDC-QA035; WRDC-TR-89-4117) Avail: NTIS HC/MF A05 CSCL 20/5

Nuclear magnetic resonance (NMR) was studied for use in the nondestructive evaluation of composite materials, with particular emphasis on NMR imaging. NMR parameters of potential use for generating images showing high contrast between acceptable and unacceptable regions of composites were measured for typical organic matrix materials. The attenuating effects of carbon fibers were measured and relationships were developed to compute the conditions necessary to obtain images of carbon fiber composites. NMR images of aerospace composites containing poly(aryl-ether-ether-ketone) (PEEK) and epoxy resins were obtained using solid state C-13 techniques. The contrast mechanism used for these images was the composites. NMR images of hydrogen in PEEK were also obtained using multiple pulse techniques to reduce dipolar broadening. Selective pulses were used to obtain images of the spatial variations in the crystalline content of PEEK. The results of these experiments were used to assess the feasibility of using NMR for nondestructive evaluation of composite materials. GRA

N91-11908# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
METAL MATRIX COMPOSITE WITH LONG FIBERS [LES COMPOSITES A MATRICE METALLIQUE A FIBRES LONGUES]
J. F. Stohr *In* AGARD, New Light Alloys Sep. 1990 39 p In FRENCH, ENGLISH summary (For primary document see N91-11905 03-26)
Copyright Avail: NTIS HC/MF A11; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N91-11909# Nottingham Univ. (England). Dept. of Materials Engineering and Materials Design.
DEVELOPMENTS IN PARTICULATE AND SHORT FIBER COMPOSITES
S. J. Harris *In* AGARD, New Light Alloys Sep. 1990 21 p (For primary document see N91-11905 03-26)
Copyright Avail: NTIS HC/MF A11; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N91-11883 Michigan Univ., Ann Arbor.
STRUCTURE OF COMBUSTING MONOPROPELLANT SPRAYS AT HIGH-PRESSURES Ph.D. Thesis
Taewoo Lee 1990 149 p
Avail: Univ. Microfilms Order No. DA9023587

An experimental and theoretical study of combusting monopropellant (hydroxylammonium-nitrate-based liquid gun propellants) sprays at pressures of 3 to 9 MPa was considered. Measurements of spray combustion properties included liquid volume fraction profiles, drop size distributions, and liquid mass flux profiles. Locally-homogeneous and separated flow analyses were developed to estimate the structure of the combusting monopropellant sprays. In addition, monopropellant drop combustion properties were observed and drop burning rates were measured (for use in the separated flow analysis) using drops supported in a combustion gas environment at pressures of 0.2 to 7.0 MPa. Observations of monopropellant drop combustion properties showed that subsurface liquid reactions leading to bubble growth and microexplosions dominated the process at low pressures while conventional surface gasification dominated the process at high pressures. The drop burning rates of 10 to 20 mm/s, with weak pressure dependence, were observed. Present findings were consistent with measurements for gelled propellants at pressures greater than 10 mPa. Present measurements of monopropellant spray combustion properties yielded a much larger liquid-containing region than earlier measurements. Furthermore, locally-homogeneous flow predictions generally overestimated rates of spray development for present test conditions, since separated-flow effects due to non-negligible relative phase velocities, finite interphase transport rates, and finite rates of drop combustion were important. In contrast, the present separated-flow analysis yielded the correct trends of variations of Sauter mean diameters, drop size distributions, and liquid mass flow rates of the sprays. Dissert. Abstr.

N91-11884 Georgia Inst. of Tech., Atlanta.
MEASUREMENT OF CORRELATIONS INVOLVING PRESSURE IN A TURBULENT PREMIXED FLAME Ph.D. Thesis
Gregor Arthur Waldherr 1990 129 p
Avail: Univ. Microfilms Order No. DA9023833

Progress in the measurement of correlations involving pressure in a turbulent premixed flame is presented. The goal is to measure all of the terms necessary to calculate the pressure-strain and pressure-scalar gradient correlations as are found in stress and scalar transport equations. A stoichiometric, turbulent premixed methane-air flame open to the surroundings is used as the test medium. The experimental techniques used are molecular Rayleigh scattering for density measurement, laser Doppler velocimetry for velocity measurement, and dynamic Pitot barometry for pressure measurement. The terms in the pressure-scalar gradient correlation which have been measured are presented and the pressure-density correlation is shown to be important in scalar transport equations. Current numerical approximation of the derivatives involved is shown to lack the accuracy needed to determine the pressure-scalar gradient correlation because of the errors involved. A new technique to accomplish these measurements was developed which involves the spatial separation of the two components of the laser Doppler velocimeter. The concept of the spatial separation was verified for a constant density air flow and then pressure-velocity correlations using both Pitot barometry and the spatial separation technique were compared, and the results show that both the spatial separation and the Pitot barometry are reliable methods to measure correlations involving pressure.
Dissert. Abstr.

N91-11885 Council for National Academic Awards (England).
A ZERO-DIMENSIONAL MODEL OF TURBULENT COMBUSTION IN A HOMOGENEOUS CHARGE SPARK IGNITION ENGINE Ph.D. Thesis
F. L. J. deCastro 1989 390 p
Avail: Univ. Microfilms Order No. BRDX89764

A zero-dimensional model of turbulent combustion was developed for the spark ignition engine. In addition to the prediction of thermodynamic state properties, the model includes the following elements: heat transfer from the combustion chamber, a geometrical model of turbulent spherical flame propagation, and detailed post flame chemical equilibria. The model is responsive to such engine operating parameters as spark timing, equivalence ratio, engine speed, and also to such design parameters as compression ratio, spark plug position, and combustion chamber geometry. Two different geometries were studied extensively with the program, namely the disc chamber and the bowl-in-piston chamber. Ethanol and isooctane were investigated as fuels during the numerical simulations at variable conditions of spark advance, equivalence ratio, engine speed, and compression ratio. The model was employed in a partly diagnostic role to predict the engine performance using different correlations for a critical model parameter, the flame speed ratio. Comparison between prediction and experiment was made possible by a diagnostic investigation of the expanding flame front into the combustion chamber of a homogeneous charge spark ignition engine. The turbulent flame speed was determined experimentally by a dual-beam laser deflection technique. The measurement of flame transit times was performed using a specially designed and built system incorporating

equipment for data acquisition based on a microcomputer. The results obtained experimentally and those obtained by the numerical simulation in general show good agreement. In the absence of detailed in-cylinder turbulence information the more fundamentally-based turbulent flame propagation models often do not perform as satisfactorily as those developed specifically for zero-dimensional engine simulation. Dissert. Abstr.

N91-11886# Army Cold Regions Research and Engineering Lab., Hanover, NH.

PURITY DETERMINATION OF STANDARD ANALYTICAL REFERENCE MATERIALS BY DIFFERENTIAL SCANNING CALORIMETRY Special Report

Patrick B. Black and Dean Pidgeon May 1990 11 p Sponsored by Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, MD

(AD-A224669; CRREL-SR-90-16; CETHA-TE-CR-89044) Avail: NTIS HC/MF A03 CSCL 14/2

Standard Analytical Reference Materials (SARMs) are a high-purity representative set of compounds used in the production of explosives. Because the National Bureau of Standards has only a limited amount of these reference materials available for trace organic analysis, the United States Army Toxic and Hazardous Materials Agency (USATHAMA) has initiated a program for developing SARMs for use in its laboratories (USATHAMA 1987). This two-part program consists of procuring and producing the high-purity reference materials and then monitoring their purity level while in storage. This paper, which is concerned with the second part of the program, reports on the method of determining the purity of the seven SARMs noted in Table 1 that are suited to differential scanning calorimetry (DSC). The purity of the remaining SARMs are determined by other methods and will not be discussed further. The USATHAMA Quality Assurance program manual (USATHAMA 1987) recommends a surveillance program that tests the purity of the SARMs at six-month intervals. For this project the criterion that is used for accepting the standard is that it does not have a purity level below 98 mol percent. If the SARM fails to meet this criterion, the central repository is to be contacted and appropriate decisions made on its status. GRA

N91-11887# State Univ. of New York, Buffalo. Dept. of Chemistry.

CLUSTER PRODUCTION IN FREE-JET EXPANSIONS: CHLOROBENZENE SEEDED IN AMMONIA

J. R. Grover (Brookhaven National Lab., Upton, NY.), W. J. Herron, M. T. Coolbaugh, William R. Peifer, and James F. Garvey Jul. 1990 14 p Submitted for publication

(Contracts N00014-88-K-0493; DE-AC02-76CH-00016)

(AD-A224692; TR-15) Avail: NTIS HC/MF A03 CSCL 20/5

Molecular beams collimated from the free jet expansion of a 200:1 ammonia-chlorobenzene mixture were analyzed to obtain the relative intensities of the neutral clusters produced, and their dependence on nozzle pressure up to 1200 torr. A single photon photoionization method was used. All species observed, (NH3)2, (NH3)4, C6H5Cl NH3, and C6H5Cl(NH3)2, rise rapidly from low pressure but decrease slowly to higher pressures, contrary to present understanding. Possible reasons for this behavior are discussed. Jet expansions of ammonia readily induce condensation, so this phenomenon has long been used to make ammonia clusters for spectroscopic, thermochemical, and reactivity studies. GRA

N91-11888# Wisconsin Univ., Milwaukee. Dept. of Mechanical Engineering.

LI-SF6 COMBUSTION IN STORED CHEMICAL ENERGY PROPULSION SYSTEMS Technical Report, 1 Oct. 1989 - 30 Sep. 1990

S. H. Chan, C. C. Tan, Y. G. Zhao, and P. J. Janke 1 Jul. 1990 69 p

(Contract N00014-89-J-1267)

(AD-A224846) Avail: NTIS HC/MF A04 CSCL 20/13

Appropriate thermodynamic models and thermo-chemical data for multicomponents and immiscible phases were incorporated into a code for the computation of chemical equilibrium of the reactants used in a stored chemical energy propulsion system. The reactants considered are molten lithium fuel and gaseous sulfur hexafluoride oxidant. Extensive equilibrium state relationships as a function of mixture fraction were presented over a temperature range of possible operating conditions. They were subsequently employed to predict the complex flow structure of a choked, turbulent, reacting SF6 gas jet submerged in a molten lithium bath. Detailed profiles of velocity, temperature, void fraction and mass fraction of all phases in the jet were presented. GRA

N91-11889# Ballistic Research Labs., Aberdeen Proving Ground, MD.

A METHODOLOGY FOR QUANTITATIVE COMPARISON OF EXPERIMENTAL TO PREDICTED CHEMICAL DEPOSITION DATA Final Report, Oct. 1989 - May 1990

Tracy P. Hindman and Bambi S. Steelman Jul. 1990 89 p

(DA Proj. 1L1-61102-AH-43)

(AD-A224877; BRL-MR-3851) Avail: NTIS HC/MF A05 CSCL 15/6

Evaluation techniques were developed to assess computer simulation of single chemical munition field trials. These techniques were used to quantitatively compare the predicted to experimental deposition data. The methods employed for evaluating single munitions are not appropriate for the multiple munition field trials that are currently being conducted. Hence, the data fitting techniques were re-examined and new methodology developed that could be applied regardless of the number of munitions tested. The statistical tests chosen were the Sign, Mann-Whitney U, and Chi-Square tests. An additional metric was a modified version of the Chi-Square, referred to as the Point-by-Point. Each test was exercised using data from eleven field trials to test its appropriateness for this application. A bet-fit criterion was established based on the evaluation of the test results. GRA

N91-11890# Air Force Armament Lab., Eglin AFB, FL.

INFRARED MATERIAL PROPERTY MEASUREMENTS WITH POLARIMETRY AND SPECTROPOLARIMETRY Interim Report

Dennis H. Goldstein, Russell A. Chipman, David B. Chenault, and Randall R. Hodgson (Alabama A & M Univ., Huntsville.) Jun. 1990 17 p Submitted for publication

(AF Proj. 2305)

(AD-A224940; AFATL-TR-90-15) Avail: NTIS HC/MF A03 CSCL 20/6

Polarimetry and spectropolarimetry are optical measurement techniques which use polarized light to obtain electrooptical material property information. These techniques are being used to make measurements on infrared electrooptical materials. Infrared materials of interest are those which find use in two dimensional modulators, i.e., optical processing applications and infrared scene projectors. Polarimetry measurements are made at one infrared wavelength at a time using laser sources. Spectropolarimetry measurements are made over an entire infrared spectral region, e.g., 2 to 14 um. A Fourier transform infrared spectrometer is the source of radiation in this case. The Mueller matrix formulation can be used to describe the polarized light and its interaction with the sample and measurement system optics. A Mueller matrix of the sample can then be obtained from a series of measurements with different input polarization states. The sample Mueller matrix contains information on the polarization properties. Electric fields are imposed on the sample as optical measurements are made. Fundamental constants associated with the sample material can be derived from the measured Mueller matrix elements. GRA

N91-11891# Rice Univ., Houston, TX. Dept. of Chemistry.

SEMICONDUCTOR CLUSTER SURFACE CHEMISTRY Interim Technical Report

Richard E. Smalley 2 Aug. 1990 21 p Presented at the ONR Cluster Science Workshop, Lake Arrowhead, CA, Jan. 1990

(Contract N00014-88-K-0553)

(AD-A224947; TR-7) Avail: NTIS HC/MF A03 CSCL 07/4

The combination of laser-vaporization supersonic cluster beam techniques with the technology of Fourier transform ion cyclotron resonance, FT-ICR, has opened a new approach to the detailed

fundamental understanding of semiconductor surface chemistry. With this apparatus it is possible to trap clusters of a specific size in a superconducting magnet under ultrahigh vacuum conditions. Through collisions with an inert thermalizing gas it is possible to slowly cool the clusters down to room temperature, allowing them to anneal to the most stable possible form. In the case of silicon this technique has revealed that certain cluster sizes (e.g., 21, 25, 33, 39, 45) are particularly stable and unreactive with reagents such a ammonia and ethylene. These clusters are believed to have taken highly symmetric crystalline forms with the bonding patterns on the surface resembling those found on bulk single crystals. Such special clusters should serve well as microscopic testing grounds for detailed theoretical predictions of semiconductor surface chemistry. GRA

N91-11892# Rice Univ., Houston, TX. Dept. of Chemistry.
DIRECT INJECTION SUPERSONIC CLUSTER BEAM SOURCE FOR FT-ICR STUDIES OF CLUSTERS Interim Technical Report
Shigeo Maruyame (Tokyo Univ., Japan), Lila R. Anderson, and Richard E. Smalley 23 Jul. 1990 23 p Submitted for publication Sponsored in part by ARO; NSF; DOE; and Robert A. Welch Foundation
(Contract N00014-88-K-0553)
(AD-A224948; TR-5) Avail: NTIS HC/MF A03 CSCL 07/5

A miniaturized pulsed supersonic beam source has been developed using laser vaporization of a computer-controlled target disc, producing intense beams of cluster ions with excellent repeatability and control. Due to its small size and narrow pulse width, the entire source is adequately pumped by a single 170 1/s turbopump. The resultant vacuum quality permits this source to be attached to a fourier transform ion cyclotron resonance apparatus (FT-ICR) such that the supersonic cluster ion beam is directly injected. The result is a powerful but simple FT-ICR instrument of wide applicability. The new source is suited as well for a variety of other uses such as molecular beam epitaxy. GRA

N91-11893# California Univ., Los Angeles. Dept. of Physics.
ELECTRONIC STUDY OF Pt-Ga INTERMETALLIC THIN FILMS USING X RAY PHOTOEMISSION SPECTROSCOPY Technical Report No. 4, 1 Oct. 1989 - 31 May 1990
Young K. Kim, David K. Shuh, R. Stanley Williams, Larry P. Sadwick, and Kang L. Wang 1 Jul. 1990 21 p Submitted for publication
(Contract N00014-90-J-1178)
(AD-A225036) Avail: NTIS HC/MF A03 CSCL 07/2

Single-phase films of Pt-Ga intermetallic compounds with different stoichiometric compositions were grown using molecular beam epitaxy (MBE) and investigated with X-ray photoemission spectroscopy (XPS). The qualitative aspects of the peak shifts and shapes are consistent with those of other compounds that have been previously investigated. Semi-quantitative analyses show that the valence bands are dominated by Pt-Ga hybridization, rather than by Pt d-d interactions, and that the final state effects dominate initial state charge transfer in determining the binding energies (BE) of the Pt core level peaks. GRA

N91-11894# California Univ., Los Angeles. Dept. of Chemistry.
SOLID-PHASE EQUILIBRIA FOR METAL-SILICON-OXYGEN TERNARY SYSTEMS 1: Mg, Ca, Sr, AND Ba Technical Report No. 3, 1 Oct. 1989 - 31 May 1990
Haojie Yuan and R. Stanley Williams 1 Jul. 1990 23 p
(Contract N00014-90-J-1178)
(AD-A225038) Avail: NTIS HC/MF A03 CSCL 07/4

Ternary phase diagrams for systems of the type M-Si-O, where M is Mg, Ca, Sr, and Ba, have been derived. These phase diagrams can be used to understand experimental results reported in the literature for thin film chemical reactions of SrO on Si and provide guides in designing stable structures that involve different materials in intimate contact. These particular phase diagrams are especially relevant for investigating the chemical stability of interfaces between SiO2 and the oxide superconductors. GRA

N91-11895# Missouri Univ., Rolla. Dept. of Ceramic Engineering.
CHARACTERIZATION OF ELECTRICALLY CONDUCTING OXIDES Report, 16 Jan. - 31 Dec. 1989
H. U. Anderson and D. M. Sparlin 1989 8 p
(Contract DE-FG02-85ER-45219)
(DE91-000596; DOE/ER-45219/4) Avail: NTIS HC/MF A02

This report discusses some of the highlights and publications of this years work. Listed below are the areas of interest and progress within the program: The studies of the Ba2YCu3O(7-x) system have shown that the conduction processes (metallic or small polaron) have little temperature dependence and are almost entirely a function of oxygen stoichiometry. The substitution of 10 to 20 m percent Ca and Co into LaCrO3 has enabled the system to be sintered to greater than 95 percent TD at 1400 C without deterioration of either the electrical conductivity or high temperature stability of the resulting dense ceramics. An elucidation of the structure of the high temperature (1400 C) phases of La substitute SrTiO3 has demonstrated our abilities to determine small changes in structure as well as to determine cation defect concentrations using x ray powder diffraction methods. In this study we were able to show that the oxidized state of Sr(1-x)La(x)TiO3 contained cation vacancies. The studies in the Y(1-x)Ca(x)CrO(3 system also are yielding some important results. They are showing that this oxide system is more stable toward reduction than LaCrO3. The construction of dual high temperature controlled atmosphere dilatometer has been completed. An effective-medium theory of hopping transport in binary systems is explaining the conductivity changes that occur when Mn is substituted into LaCrO3. DOE

N91-11896# Miami Univ., Coral Gables, FL.
MAGNETIC MULTILAYER INTERFACE ANISOTROPY Technical Progress Report, 1 Aug. - 31 Dec. 1990
Michael J. Pechan 1990 7 p Submitted for publication
(Contract DE-FG02-86ER-45281)
(DE91-000702; DOE/ER-45281/5) Avail: NTIS HC/MF A02

Ni/Mo and Ni/V multilayer magnetic anisotropy was investigated as a function of Ni layer thickness, frequency and temperature. Variable frequency ferromagnetic resonance (FMR) measurements show, for the first time, significant frequency dependence associated with the multilayer magnetic anisotropy. The thickness dependence allows one to extract the interface contribution from the total anisotropy. Temperature dependent FMR (9 GHz) and room temperature magnetization indicate that strain between Ni and the non-magnetic layers is contributing significantly to the source of the interface anisotropy and the state of the interfacial magnetization. In order to examine the interface properties of other transition metal multilayer systems, investigations on Fe/Cu are underway and CoCr/Ag is being proposed. ESR measurements have been reported on Gd substituted YBaCuO superconductors and a novel quasi-equilibrium method has been developed to determine quickly and precisely the transition temperature. During the next project period it is proposed to (1) extend the variable frequency FMR measurements to low temperature, where extremely large interface anisotropies are known to obtain in Ni/Mo and Ni/V and are proposed to exist in Ni/W; (2) obtain accurate dc anisotropies via a novel, variable temperature torque magnetometer currently under construction; (3) expand upon his initial findings in Fe/Cu multilayer investigations; (4) begin anisotropy investigations on Co/Ag and CoCr/Ag multilayers where the easy magnetization direction depends upon the Cr concentration; and (5) make and characterize Bi based superconductors according to resistivity, thermal conductivity and thermoelectric power and construct YBaCuO based superconducting loop-gap resonators for use in the magnetic resonance work. DOE

N91-11897# Universiteit Twente, Enschede (Netherlands).
STABILITY OF SUPPORTED LIQUID MEMBRANES Ph.D. Thesis
Antonius Maria Neplenbroek 1989 154 p Sponsored by Netherlands Ministry of Economic Affairs

(ISBN-90-90031-32-4; ETN-90-97763) Copyright Avail: NTIS HC/MF A08

The results of research into the mechanisms of Supported Liquid Membranes (SLMs) degradation are described with the purpose of providing guidelines for the development of stable liquid membranes. An SLM system in which nitrate ions are removed from water is used as a model system for these measurements. An inventory of a number of instabillity effects of SLMs was made and verified experimentally. The correctness of an hypothesis concerning the mechanism of SLM degradation was tested. A method for improving the stability of SLMs was developed. Membranes in general and liquid membranes in particular are described. Special attention is paid to the various transport mechanims and advantages of LM processes and the instabillity problem of SLMs. ESA

N91-11898# Bonn Univ. (Germany, F.R.). Inst. fuer Physik.
SPECTROSCOPY WITH THERMIONIC DIODE AND SYNCHROTON RADIATION. EXAMINATION OF APPLICATION POSSIBILITIES Thesis [SPEKTROSCOPIE MIT THERMIONISCHER DIODE UND SYNCHROTRONSTRAHLUNG UNTERSUCHUNG DER ANWENDUNGSMOEGLICHKEITEN]
Bernd Esser Jun. 1990 51 p In GERMAN; ENGLISH summary
(Bonn-IR-90-21; ISSN-0172-8741; ETN-90-97906) Avail: NTIS HC/MF A04

Relative atomic cross sections of vaporized samples in the VUV (Vacuum Ultra Violet) range were measured, using a hot wire detector and synchroton radiation. A differential pumping system allowed measurements below the LiF cut off. Thoriated tungsten wire was used for spectroscopy on elements with high work function. Spectra of Ba, Pb, Sr, Yb, and Ca are presented. ESA

N91-11899# State Univ. of New York, Buffalo. Dept. of Chemistry.
COEFFICIENTS OF THE SECOND VISCOSITY IN THIN LIQUID-HELIUM FILMS
Chul-Won Jun, Chung-In Um, and Thomas F. George Aug. 1990 32 p
(Contract N00014-90-J-1193)
(AD-A225237; UBUFFALO/DC/90/TR-19) Avail: NTIS HC/MF A03 CSCL 07/4

The coefficients of the second viscosity in thin liquid helium films are evaluated explicitly as a function of temperature (T) via interactions between elementary excitations which include the anomalous excitation spectrum. For T greater than or = 0.3 K the coefficients behave like those of the bulk liquid helium, while for T less than or = 0.3 K the temperature variations of four coefficients of the second viscosity show a T-1-dependence, which is due to the three-phonon processes (3PP) originating from the anomalous excitation spectrum of 2-D liquid helium at low momenta and low temperatures. The 1/T-dependence also appears in the first viscosity of bulk and thin liquid helium, which is based on the 3PP. GRA

N91-11900# Pittsburgh Univ., PA. Surface Science Center.
DISSOCIATIVE ADSORPTION OF PH3 ON Si(111)-(7X7). A HIGH RESOLUTION ELECTRON ENERGY LOSS SPECTROSCOPY STUDY
P. J. Chen, M. L. Colaianni, R. M. Wallace, and J. T. Yates, Jr. 7 Aug. 1990 23 p
(Contract N00014-82-K-0280)
(AD-A225313; TR-34) Avail: NTIS HC/MF A03 CSCL 07/4

Dissociative adsorption of PH3 on Si(111)-(7x7) was observed at 80 K. The Si-H species is observed to be produced upon PH3 adsorption. Depending upon the PH3 surface coverage, PH3(a) (minority species) and PH2(a) species are found on the surface. The thermal dissociation of the surface PH2 species occurs between 450 and 500 K, resulting in the capture of hydrogen and phosphorus on the surface. GRA

N91-11901# California Univ., Berkeley. Dept. of Chemistry.
VIBRATIONALLY RESOLVED PHOTOELECTRON SPECTRA OF Si3 AND Si4 Interim Technical Report No. 4, Jan. - Jul. 1990
T. N. Kitsopoulos, C. J. Chick, A. Weaver, and D. M. Neumark 1 Aug. 1990 17 p Submitted for publication
(Contract N00014-87-K-0495)
(AD-A225383) Avail: NTIS HC/MF A03 CSCL 09/1

Photoelectron spectra of the Si3- and Si4- cluster anions have been obtained at 355 nm and 266 nm. The spectra show transitions to the ground and low-lying excited electronic states of the neutral clusters. Several of the electronic bands show resolved vibrational structure. The electronic state energies and vibrational frequencies are compared to recent ab initio calculations. The Si4- spectrum is consistent with the prediction of a planar, symmetric rhombus for the ground state of Si4. GRA

N91-11902# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Dienstleistungsbereich.
ANISOTROPIC ETCHING OF CRYSTALLINE SILICON IN ALKALINE SOLUTIONS. PART 1: ORIENTATION DEPENDENCE AND BEHAVIOR OF PASSIVATION LAYERS
H. Seidel, L. Csepregi, A. Heuberger, and H. Baumgaertel (Freie Univ., Berlin, Germany, F.R.) 1989 77 p
(MBB-Z-0311-89-PUB-1-Pt-1; OTN-03078347-1-Pt-1; ETN-90-98147) Avail: NTIS HC/MF A05

The anisotropic etching behavior of single crystal silicon and the behavior of SiO and Si3N4 in an ethylenediamine based solution as well as in aqueous KOH, NaOH, and LiOH were studied. The crystal planes bounding the etch front and their etch rates were determined as a function of temperature, crystal orientation, and etchant composition. A correlation was found between the etch rates and their activation energies, with slowly etching crystal surfaces exhibing higher activation energies and vice versa. For highly concentrated KOH solutions, a decrease of the etch rate with the fourth power of the water concentration was observed. Based on these results, an electrochemical model is proposed, describing the anisotropic etching behavior of silicon in all alkaline solutions. According to this model, monosilicic acid Si(OH)4 is formed as the primary dissolution product in all anisotropic silicon etchants. The anisotropic behavior is due to small differences of the energy levels of the background surface states as a function of the crystal orientation. ESA

N91-11903# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Dienstleistungsbereich.
ANISOTROPIC ETCHING OF CRYSTALLINE SILICON IN ALKALINE SOLUTIONS. PART 2: INFLUENCE OF DOPANTS
H. Seidel, L. Csepregi, A. Heuberger, and H. Baumgaertel (Freie Univ., Berlin, Germany, F.R.) 1989 39 p
(MBB-Z-0311-89-PUB-2-Pt-2; OTN-030783-2-Pt-2; ETN-90-98148) Avail: NTIS HC/MF A03

The etching behavior of highly boron doped silicon in aqueous solutions based on ethylenediamine, KOH, NaOH, and LiOH was studied. For all etchants, a strong reduction of the etch rate for boron concentrations exceeding approximately 2 times 10 to the 19th power/cubic cm was observed. The reduction of the etch rate was found to be inversely proportional to the fourth power of the boron concentration. For a given high boron concentration, the etch stop effect was found to be most effective for ethylenediamine based solutions and lowly concentrated KOH and least effective for highly concentrated KOH. On the basis of these results, a model is proposed attributing the etch stop phenomenon to electrical effects of holes rather than chemical effects of boron. ESA

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N91-11904 Cornell Univ., Ithaca, NY.
METAL/SEMICONDUCTOR INTERACTIONS Ph.D. Thesis
Leslie Henry Allen 1990 195 p
Avail: Univ. Microfilms Order No. DA9027142

A study of metal/semiconductors interactions during thermal annealing is investigated. Two general areas are discussed: bilayer reactions between Au and poly Si, and interface contact resistance of two systems as related to ohmic contacts and growth and nucleation. In the Au/polycrystalline-Si system the growth of large two-dimensional Si crystals is observed after thermally annealing the system below the eutectic temperature. Si is transported from the fine grain polysilicon laterally through the Au layer to form large (400 sq microns) plate-like shaped single crystals of Si of thickness equal to that of the Au layer. The driving force for this transformation is the reduction of the interface energy at the grain boundaries of the polysilicon. It is deduced from pole figure x ray data that the large grains result from grain growth of existing Si grains rather than nucleation and growth. The kinetics of Si recrystallization were also investigated via scanning electron microscopy (SEM) and in-situ sheet resistance measurements. In the final analysis the activation energy of the total process is related to the activation energy of adding/removing an atom from the Si surface and the diffusion of Si in Au. The interface contact resistance between In/Pd and GaAs layers was reduced by a factor of 10(exp 6), changing from rectifying to an ohmic characteristics with contact resistivity, P(sub c), of approximately 10(exp -6) sq cm. There is a correlation of the change in resistance with the formation of In rich In(1-x)Ga(x)As compounds as determined from x ray diffraction. The low contact resistance is attributed to the lower bandgap In(1-x)Ga(x)As heterojunctions. Contact resistance is also used as a characterization method for the growth and nucleation of tungsten in the selective chemical vapor deposition (CVD) process. High interface resistance of the Al/W interface is attributed to surface oxides which inhibit the nucleation of tungsten. Dissert. Abstr.

N91-11905# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Structures and Materials Panel.
NEW LIGHT ALLOYS
Sep. 1990 245 p In ENGLISH and FRENCH Lectures held in Madrid, Spain, 15-16 Oct. 1990; in Toulouse, France, 18-19 Oct. 1990; and in Monterey, CA, 29-30 Oct. 1990
(AGARD-LS-174; ISBN-92-835-0588-3) Copyright Avail: NTIS HC/MF A11; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Developments in research, manufacture, and exploitation of new light alloys (based on aluminium and magnesium) are reviewed for structural applications in aeronautics and space. These new alloys exhibit significant potential for reducing structural weight and are gaining recognition as competitive materials within the aerospace industries. Topics addressed in the lectures include: metal physics and processing aspects, properties of existing materials, and prospects for future development and exploitation. For individual titles, see N91-11906 through N91-11912.

N91-11906# Royal Aerospace Establishment, Farnborough (England). Dept. of Materials and Structures.
THE DEVELOPMENT OF ALUMINUM LITHIUM ALLOYS: AN OVERVIEW
C. J. Peel *In* AGARD, New Light Alloys Sep. 1990 55 p (For primary document see N91-11905 03-26)
Copyright Avail: NTIS HC/MF A11; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

For the last decade the aluminium industry has been redeveloping aluminium-lithium alloys for aerospace use. While not new in concept or in technology, these alloys would appear to offer the aircraft designer as much weight saving as non-metallic composite materials with the added advantage of the continued employment of well developed manufacturing routes supported by existing expensive equipment. It is clear that, were it not for significant technical and production difficulties, many of the airframes produced today would already be manufactured in aluminum-lithium alloy. Not only the property advantages that enable very significant weight savings to be achieved, but those difficulties that are being slowly overcome by intensive effort are highlighted. The scale of this effort can be judged by the fact that the last of the five International Conferences, held exclusively on aluminum -lithium alloys, produced over 1700 pages of print. It is far beyond the scope of this paper to comprehensively review this aggregated volume of work but an attempt is made to precis those aspects thought to be most relevant to the successful outcome of the development. Author

N91-11907# Virginia Univ., Charlottesville. School of Engineering and Applied Science.
THE MICROSTRUCTURE AND PROPERTIES OF ALUMINUM-LITHIUM ALLOYS
Edgar A. Starke, Jr. and William E. Quist (Boeing Commercial Airplane Co., Seattle, WA.) *In* AGARD, New Light Alloys Sep. 1990 21 p Previously announced as N90-15187 (For primary document see N91-11905 03-26)
(Contracts DAAL03-86-K-0128; N00014-85-0526; AF-AFOSR-0082-87)
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The advantage to be gained by weight reduction of aerospace structures have encouraged the aluminum industry to develop a family of aluminum alloys which contain lithium as one of the alloying elements. When alloyed with aluminum, lithium can reduce the density by approximately three percent and increase the elastic modulus by six percent for every weight percent added. A new series of aluminum alloys, typified by 2090, 2091, 8090, and 8091, were developed and are currently being produced in commercial quantities. These alloys have densities between 7 and 10 percent lower than the conventional alloy 7075 with correspondingly higher stiffness. Although a combined set of specific properties of the Al-Li-X alloys often exceeds those of the conventional aluminum materials used in aerospace, these properties seem to be much more sensitive to processing parameters. The strong processing-property relationship is associated with sharp crystallographic textures that are developed during primary processing and very complex precipitate microstructures whose distributions are sensitive to quench rates and degree of deformation prior to aging. The processing-microstructure property relationships of the new Al-Li-X alloys are described and the focus is on strength, ductility, fracture toughness, fatigue and stress corrosion properties. Author

N91-11908# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
METAL MATRIX COMPOSITE WITH LONG FIBERS [LES COMPOSITES A MATRICE METALLIQUE A FIBRES LONGUES] **c24**
J. F. Stohr *In* AGARD, New Light Alloys Sep. 1990 39 p In FRENCH, ENGLISH summary (For primary document see N91-11905 03-26)
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The reinforcement of metal matrices by long ceramic fibers such as alumina, carbon, silicium carbide, leads to very high specific characteristics such as stiffness and strength at both room and high temperature. Progress achieved in the development of new fibers performance has revived the interest for metal matrix composites (MMC) development. After having briefly reviewed the basic laws of unidirectional composites linear mechanics and shed some light on the major role played by fiber-matrix interface in the micromechanics and behavior of these materials, their processing techniques and characteristics are examined. The improvement of the mechanical characteristics of the new generation of composites arises not only from the fiber surface

treatment leading to a control of fiber matrix bond strength, but also to the processing techniques derived either from casting or rapid solidification rate techniques. Mechanical characteristics of the most relevant MMC are presented for both metallic and intermetallic matrices. Attention is drawn to particular behavior such as thermal expansion, thermal cycling, and corrosion resistance. Author

N91-11909# Nottingham Univ. (England). Dept. of Materials Engineering and Materials Design.
DEVELOPMENTS IN PARTICULATE AND SHORT FIBER COMPOSITES **c24**
S. J. Harris *In* AGARD, New Light Alloys Sep. 1990 21 p (For primary document see N91-11905 03-26)
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Major programs exist in the USA and Europe to produce lightweight, stiff, and strong metallic materials with the aid of discontinuous reinforcement. These efforts relate to light metal matrix alloys (aluminum, magnesium, and titanium) and the use of short fibers, whiskers, and particles of ceramics to provide the necessary reinforcement. Major interest was recently centered on the development of particulate reinforcement of aluminum alloys. The various methods of producing these metal matrix composites are reviewed. Then the influences of reinforcement size, shape and volume fraction, matrix alloy selection, processing route and heat-treatment on the mechanical properties, e.g. stiffness, strength, and toughness of the composites, are discussed. Microstructural evidence is used to interpret property data where possible. Elevated temperature and creep properties are described, as well as the ability of these composites to handle thermal cycling. Other properties, e.g. fatigue and corrosion, which influence the life of components fabricated from these materials also come under review. Author

N91-11910# Aluminum Co. of America, Alcoa Center, PA.
ALUMINUM POWDER ALLOYS: AN OVERVIEW
Gregory J. Hildenman and Michael J. Koczak (Drexel Univ., Philadelphia, PA.) *In* AGARD, New Light Alloys Sep. 1990 25 p (For primary document see N91-11905 03-26)
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The historic development of aluminum powder metallurgy dates back to the early 1900s with initial flake powder production and has matured to the present day production of viable aerospace alloys. Primary powder production and processing techniques, such as atomization and mechanical alloying are reviewed. Processing-microstructure-property relationships in four classes of high performance powder metallurgy (PM) aluminum alloys are considered. These are high strength alloys (Al-Zn-Mg-Cu-Co); high specific modulus alloys (Al-Li-Cu); high temperature alloys (Al-Fe-Co, Al-Fe-Ni); mechanically alloyed material (Al-Mg) and composite alloys. Direct property comparisons with counterpart ingot metallurgy alloys are presented wherever appropriate. Aluminum powder metallurgy alloy development is now at a mature stage of growth where commercial and aerospace application are being sought and developed in competition with traditional aluminum ingot metallurgy, titanium, and composite structures. The future growth and development of these alloy systems is vested in reliable economic processing and design reliability. Author

N91-11911# Ecole des Mines, Nancy (France).
PHYSICAL METALLURGY OF ALUMINUM POWDER ALLOYS
Georges Champier *In* AGARD, New Light Alloys Sep. 1990 21 p (For primary document see N91-11905 03-26)
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The discovery of new alloy compositions and new processes increases the application field of aluminum alloys. In particular the powder metallurgy route allows alloying with transition and rare earth metals, oxygen and carbon usually forbidden by the classical ingot metallurgy route. Further improvements can be obtained by rapid solidification and/or mechanical alloying by modifying the microstructures. The relation between microstructure and mechanical properties of high strength alloys for room temperature applications (7090, 7091, CW67 and Al-C-O), and alloys for high temperature applications (Al-Fe-Ce, Al-Fe-V-Si, Al-Cr-Zr, Al-Zr-V, Al-Cr-Y, and some other under studies) are examined. Author

N91-11912# Royal Aerospace Establishment, Farnborough (England). Dept. of Materials and Structures.
CAST AND RAPIDLY SOLIDIFIED MAGNESIUM ALLOYS
D. J. Bray *In* AGARD, New Light Alloys Sep. 1990 29 p (For primary document see N91-11905 03-26)
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Recent developments in magnesium alloy technology will be described. The majority of applications for magnesium alloys in the aerospace industry are in castings. A range of yttrium containing alloys was introduced for high temperature applications, and the corrosion resistance of Mg-Al-Zn cast alloys was improved by increasing the alloy purity. Fluxless melting, to reduce the number of inclusions, is now common, and low pressure casting permits more complex, thin walled components to be made. For gearbox casings, a polyimide coating was developed which resists attack by lubricating oils up to 225 C. Further development of magnesium alloys by ingot metallurgy is limited by the structure of the phase diagram of many magnesium alloy systems. To overcome these restrictions, attention is now turning to the rapid solidification of magnesium alloys and progress in this field is reviewed. Author

N91-11913# General Electric Co., Schenectady, NY. Corporate Research and Development.
DEVELOPMENT OF ELEMENTS OF A HIGH Tc SUPERCONDUCTING CABLE Report, 1 Jul. 1989 - 30 Jun. 1990
Kenneth W. Lay 30 Jun. 1990 8 p
(Contract N00014-88-C-0681)
(AD-A224971) Avail: NTIS HC/MF A02 CSCL 11/6

Further effort on the YBaCu3O(7-x) (YBCO) system will not be likely to result in a polycrystalline conductor with the desired critical current. A realignment of the program has been undertaken with the effort redirected to the use of a Bismuth Strontium Calcium Cuprate (BSCCO) conductor at 20 K. This was done because of the abundant evidence for the much greater critical currents possible in polycrystalline BSCCO. The overall goal of the program, the development of materials and processes for the fabrication of a composite high Tc superconductor element, remains unchanged. The goal of the program was the development of materials and processes for the fabrication of a composite YBCO element made of a superconducting coating on a supporting fiber. The proposed application was a dc transmission line operating at 77 K. At mid-program a decision was to be made on the feasibility of fabricating a long-length conductor of polycrystalline YBCO. At this time there is no solution in sight for the weak-link low JC problem in long polycrystalline YBCO wires. GRA

N91-11914# California Univ., Berkeley. Lawrence Berkeley Lab. Center for Advanced Materials.
TEXTURAL CHARACTERIZATION AND ITS APPLICATIONS ON ZINC ELECTROGALVANIZED STEELS
S. J. Shaffer, J. W. Morris, Jr., and H.-R. Wenk May 1990 17 p Presented at the Fall Meeting of the Minerals, Metals, and Materials Society on Physical Metallurgy and Materials in Conjunction with Materials Week and the Material Applications and Services Exposition, Detroit, MI, 7-11 Oct. 1990 Sponsored in part by Ford Motor Co.; Rouge Steel Co.; and LTV Steel Co.
Prepared in cooperation with California Univ., Berkeley
(Contract DE-AC03-76SF-00098)
(DE91-000354; LBL-29185; CONF-901008-3) Avail: NTIS HC/MF A03

Methods of characterization and description of crystallographic texture in both laboratory prepared and commercial zinc electrogalvanized steel sheets are presented. Specific examples of simple in-plane normalization techniques, and pole figures obtained from deformation and friction studies are presented.

Strong evolutions of texture are observed in friction testing. Coatings containing orientations which are unfavorable for slip show evidence of twinning and possibly recrystallization. The use of the complete orientation distribution function (ODF) is discussed with reference to deformation modelling studies and quantitative analysis of textural changes with depth. Other ODF applications include extraction of textural changes solely of the deformed surface layer resulting from friction testing as well as texture changes with coating thickness in as deposited coatings. DOE

N91-11915# Rolls-Royce Ltd., Derby (England).
PROCESS MODELLING
O. L. Towers 6 Dec. 1989 61 p Presented at Institute of Metals Seminar of Characterization of High Temperature Materials. 5: Numerical Techniques, 6 Dec. 1989
(PNR-90716; ETN-90-97943) Copyright Avail: NTIS HC/MF A04

The requirements of a process model are reviewed with respect to how to reduce lead times through close integration between design and manufacture. Particular needs to be met are covered for casting, forging and heat treatment. The modeling of casting and forging are described as examples. Orientation is towards modeling the manufacture of high temperature components for jet engines. ESA

N91-11916# Naval Postgraduate School, Monterey, CA.
A COMPARISON OF THE AGING KINETICS OF A CAST ALUMINA-6061 ALUMINUM COMPOSITE AND A MONOLITHIC 6061 ALUMINUM ALLOY M.S. Thesis
Johanna L. Hafley Dec. 1989 61 p
(AD-A225398) Avail: NTIS HC/MF A04 CSCL 11/6

Electrical resistivity and hardness measurements were conducted during isothermal aging treatments of an alumina particulate reinforced 6061 aluminum metal matrix composite and a monolithic 6061 aluminum control material. Transmission electron microscopy was utilized to examine the microstructural changes accompanying the changes in the resistivity of the monolithic during aging. In addition, differential scanning calorimetry was used to investigate the growth kinetics and thermal stability of the metastable phases in the control sample. The heats of formation of the metastable phases were determined as functions of aging time and temperature. These results were used to characterize the aging behavior of the matrix material. GRA

N91-11917# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Abt. Metallurgie.
CHEMICAL TREATMENT OF ALUMINUM ALLOY POWDER SURFACES
Guenter Staniek and Uwe Hoppe May 1990 47 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1240)
(DLR-FB-90-21; ISSN-0171-1342; ETN-90-98043) Copyright Avail: NTIS HC/MF A03; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 19 Deutsche marks

The improvement of the mechanical properties of powder metallurgy extrusion products such as the elongation and the rupture viscosity was addressed. Powders were treated with chemical solutions, dried and extruded to show an alternative to degassing, generally used to drop the effects of the surface oxides on powder particles. During the chemical treatment, the oxide skin on powder particles is completely or partially dissolved and new oxides with improved properties appear. Fracture toughness is increased and consolidation of powders is facilitated. ESA

N91-11918# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Inst. fuer Raumsimulation.
NON-EQUILIBRIUM SOLIDIFICATION IN UNDERCOOLED METALLIC MELTS Ph.D. Thesis - Ruhr Univ.
Ekkehard Schleip May 1990 137 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1241) Sponsored by DFG
(DLR-FB-90-23; ISSN-0171-1342; ETN-90-98045) Copyright Avail: NTIS HC/MF A07; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 40 Deutsche marks

Phase selection processes are studied in undercooled iron and iron-nickel melts. The primary solidifications are identified by measured temperature-time profiles in situ. The results are discussed by means of an entropic model for the surface energy between liquid and solid phases, which predicts a nucleation of the metastable bcc-phase in the case of an iron-nickel alloy. It was shown that a metastable phase can be seeded by moving the undercooled melt with a trigger crystal of suitable catalytic effect. The growth front velocity was measured in iron and CuNi melts, as a function of undercooling. The results are favorably compared with the predictions of actual dendritic growth models, particulary as regards the deviations from the local thermodynamic equilibrium at the growth front. The examination of the microstructures of the iron samples shows a good correlation with the measured growth rates. ESA

N91-11833# Joint Research Centre of the European Communities, Ispra (Italy). Materials Reliability and Performance Div.
MICROSTRUCTURE AND PROPERTIES OF ALUMINIUM ALLOY 7050 ELECTRON BEAM WELDMENTS
M. Vedani, F. DosSantosMarques, G. Tuberga, G. Piatti, and V. Wagner (Aeronautica Macchi S.p.A., Varese, Italy) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 137-142 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11849# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Central Labs.
DEVELOPMENT OF FABRICATION METHODS FOR METALLIC MULTILAYER STRUCTURES
W. Keinath and P.-J. Winkler *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 241-246 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11857# BHP Labs. Ltd., Limerick (Ireland).
ALUMINIUM-LITHIUM ALLOYS: A REVIEW AND ASSESSMENT
B. OBrien and A. Pradier (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 293-300 (For primary document see N91-11812 03-24)
(Contract ESTEC-7807/88/NL)
Copyright Avail: NTIS HC/MF A19

N91-11858# Raufoss Ammunisjonsfabrikker (Norway).
OXIDE DISPERSION STRENGTHENED ALUMINIUM: PROPERTIES AND USE
Einar Hellum and Michael J. Luton (Exxon Research and Engineering Co., Annandale, NJ.) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 301-305 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11859# Raufoss Ammunisjonsfabrikker (Norway).
CARBON FIBRE REINFORCED ALUMINIUM: MANUFACTURING AND PROPERTIES
Ragnar Holthe and Kolstein Asboll *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 307-312 Sponsored by Norwegian Space Agency (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11860# Technische Univ., Delft (Netherlands). Dept. of Structures and Materials.
NEW DEVELOPMENTS IN FIBRE METAL LAMINATES (ARALL)
C. A. J. R. Vermeeren, L. B. Vogelesang, and J. W. Gunnink *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 313-317 (For primary document see N91-11812 03-24)
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27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials*.

N91-11919 Minnesota Univ., Minneapolis.
MORPHOLOGY AND RHEOLOGY OF SILICA-REINFORCED SILICONE RUBBERS Ph.D. Thesis
Mirta Ines Aranguren 1990 261 p
Avail: Univ. Microfilms Order No. DA9024263

The mechanism of reinforcement of elastomers with particulate fillers is explained. One of the most dramatic examples of this type of reinforcement is given by the fumed silicapolydimethylsiloxane system and thus, it was chosen for this study. Fumed silicas consist of very small 'spheres' of SiO2 (10 to 15 nm in diameter) fused together forming irreversible clusters called aggregates. Vinyl terminated polydimethylsiloxanes (PDMS) with number average molecular weights ranging from 9,000 to 150,000 and polydispersity = 2 were used throughout this work. Different techniques were used to characterize the morphology and type of bonds in the PDMS rubber: electron microscopy, infrared spectroscopy, gel permeation chromatography and others that are specific to the study of rubbers (i.e., bound rubber). The main effort, however, was directed towards the understanding of the rheology of the rubbers. The rheological response of the composites is in general a function of: the structure and surface chemistry of the silica, the molecular weight and molecular weight distribution of the PDMS and the deformation history of the material. This behavior is explained as the result of the connection of silica aggregates via polymer chains adsorbed onto their surfaces. Qualitative differences were found between composites prepared with PDMS of molecular weights below or above the critical molecular weight for entanglements. The effects of polymer molecular weight, silica concentration, silica surface treatment on the rheology of the uncured composites (processing step), and cured composites (final properties) were examined. Finally, the use of hydrodynamic models of reinforcement is discussed.
Dissert. Abstr.

N91-11920*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE MECHANICAL STABILITY OF POLYIMIDE FILMS AT HIGH pH
Catharine I. Croall (Lockheed Engineering and Sciences Co., Hampton, VA.) and Terry L. St.Clair Oct. 1990 43 p
(NASA-TM-102726; NAS 1.15:102726) Avail: NTIS HC/MF A03 CSCL 11C

Polyimide insulated electrical wire has been widely used in the aerospace industry in commercial, military, and to a lesser degree, general aviation aircraft since the early 1970s. Wiring failures linked to insulation damage have drawn much attention in the media and concerns have developed regarding the long term stability and safety of polyimide insulated electrical wire. The mechanical durability and chemical stability of polyimide insulated wire are affected by hydrolysis, notch propagation, wet and dry arc tracking, topcoat flaking, and degradation due to high pH fluids. Several polyimides were selected for evaluation for resistance to degradation by various aqueous alkaline solutions. The polyimides under evaluation include commercially available films such as KAPTON (tradename), APICAL (tradename), LARC-TPI, and UPILEX (tradename) R and S, as well as a number of experimental films prepared at NASA-Langley. Material properties investigated include viscosity, solubility, moisture absorption, glass transition temperature, dielectric constant, and mechanical properties before and after exposure to various conditions. Author

N91-11921# Centre National d'Etudes Spatiales, Toulouse (France).
SILICON ELASTOMERS IN STRUCTURAL GLASS ADHESION. APPLICATION: SILOVITRAIL [LES ELASTOMERES SILICONES DANS LE COLLAGE STRUCTURAL DU VERRE. APPLICATION: SILOVITRAIL]
Pierre Souleille, Michel Bataillou, and Daniel Bataillou (L'Atelier du Vitrail, Toulouse, France) Dec. 1987 78 p In FRENCH; ENGLISH summary
(Contract ANVAR-A86-02-019-M)
(ETN-90-97804) Copyright Avail: NTIS HC/MF A05

The purpose of the work is to allow a transfer of space technology towards construction, concerning the utilization of stained glass. The main axes of the research program for the transfer of technology of those materials is sketched. The technique presented was developed for protecting detectors in space. The phenomena of adhesion are discussed. Aging tests confirm that the proposed product and method can have 10 years guarantee.
ESA

N91-11922*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
USES OF AUGER AND X RAY PHOTOELECTRON SPECTROSCOPY IN THE STUDY OF ADHESION AND FRICTION
Kazuhisa Miyoshi Aug. 1990 13 p Presented at the 1st International Symposium on Industrial Tribology, Chicago, IL, 29-31 Aug. 1990; sponsored in part by NSF
(NASA-TM-103266; E-5631; NAS 1.15:103266) Avail: NTIS HC/MF A03 CSCL 11C

Three studies are described characterizing the possible contributions of surface science to tribology. These include surface contamination formed by the interaction of a surface with the environment, contaminants obtained with diffusion of compounds, and surface chemical changes resulting from selective thermal evaporation. Surface analytical tools such as Auger electron spectroscopy (AES) and x ray photoelectron spectroscopy (XPS) incorporated directly into adhesion and friction systems are primarily used to define the nature of tribological surfaces before and after tribological experimentation and to characterize the mechanism of solid-to-solid interaction. Emphasis is on fundamental studies involving the role of surfaces in controlling the adhesion and friction properties of materials emerging as a result of the surface analyses. The materials which were studied include metals and ceramics such as elemental metals, amorphous alloys (metallic glasses), and silicon-based ceramics. Author

N91-11923# Argonne National Lab., IL. Chemistry Div.
LASER DESORPTION/PHOTOIONIZATION TIME-OF-FLIGHT MASS SPECTROMETRY OF POLYMER ADDITIVES
J. E. Hunt, K. R. Lykke, and M. J. Pellin 1990 7 p Presented at the NATO Advanced Research Workshop on Methods and Mechanisms for Producing Ions from Large Molecules, Ontario, 24-28 Jun. 1990 Submitted for publication
(Contract W-31-109-eng-38)
(DE90-017808; CONF-9006271-1) Avail: NTIS HC/MF A02

Laser desorption mass spectrometry has proven to be a very useful tool in the analysis of non-volatile organic materials. Laser desorption (LD) along with other mass spectrometric techniques such as fast atom bombardment and (235)Cf plasma desorption have greatly extended the ability of mass spectroscopy to characterize complex substances. Laser desorption with a single laser wavelength has achieved some success in analysis of organic polymer additives. In this case the desorption laser also acts as the ionization laser, limiting the ion yield, and ultimately, the sensitivity. Furthermore, the ion yield may depend critically on the matrix, as demonstrated in matrix assisted laser desorption of proteins. Earlier work has suggested that a two laser scheme, separating the desorption step from the ionization step, can be useful in characterizing complex substances. A laser desorption/photoionization time-of-flight mass spectrometer (LD/PI TOF) is described along with the feasibility of laser desorption coupled with photoionization of neutrals for characterization of polymer additives. Present day polymers are complex mixtures of not only the base polymer, but also many additives which determine the characteristics of the polymer in a critical way. The analysis of polymer additives by mass spectrometry has remained a considerable challenge because of the complexity of commercial polymer formulations. The main advantage of this technique results

from the separation of the desorption and ionization processes. Furthermore, separation of the desorption and ionization steps offers possibilities for the investigation of the desorption process. Some information is presented about the initial velocity distributions of desorbed neutral species obtained with the LD/PI TOF spectrometer. DOE

N91-11924# Texas A&M Univ., College Station.
ON-LINE QUANTITATIVE NONDESTRUCTIVE EVALUATION AND CHARACTERIZATION OF TOUGH CERAMICS AT OPERATING TEMPERATURES (DURIP) Final Report, 1 Dec. 1988 - 31 May 1990
Christian P. Burger 25 Jun. 1990 7 p
(Grant AF-AFOSR-0112-89; AF Proj. 2302)
(AD-A224730; AFOSR-90-0773TR) Avail: NTIS HC/MF A02 CSCL 09/3

A grant of $70,000 from the Airforce Office of Scientific Research (AFOSR) was used to buy a 600W CO2 laser. This was combined with items bought with supplemental funds from other sources to assemble a facility for characterization of ceramic materials at extremely high temperatures (up to 2000C is anticipated) in air. The system splits the laser beam into two equal components each of which is coupled into its own computer controlled galvanometric scanner that scans the beam rapidly over a central portion of the front or back surface of a flat specimen. The scan rate and scan density is controlled to yield a test volume, in the mid-section of the specimen, that is at uniform temperature and free of thermal stresses. Related research is developing non-contact methods for stain measurements and damage detection within the central volume of material that is at the test temperature. Characterization of material properties and behavior in a wide range of severe environments will be possible with this system. GRA

N91-11925# Waterloo Univ. (Ontario). Dept. of Chemistry.
AN EXAMINATION OF THE RELATIONSHIP BETWEEN SURFACE ENHANCED RAMAN SCATTERING (SERS) INTENSITIES AND SURFACE CONCENTRATION FOR PYRIDINE ADSORBED AT THE POLYCRYSTALLINE GOLD/AQUEOUS SOLUTION INTERFACE Technical Report, May 1989 - Jul. 1990
L. Stolberg, J. Lipkowski (Guelph Univ., Ontario), and D. E. Irish 5 Jul. 1990 49 p Submitted for publication
(Contract N00014-87-J-1118)
(AD-A224801; TR-16-ONR) Avail: NTIS HC/MF A03 CSCL 20/5

Surface enhanced Raman scattering (SERS) data are presented for pyridine adsorbed onto both smooth and roughened polycrystalline gold electrode surfaces. It was found that, for smooth surfaces, time independent (stable to within 10 percent of the initial value) intensities of the totally symmetric ring breathing mode of pyridine could be measured by applying slow oxidation-reduction cycles between each intensity measurement. The potential and concentration dependence of the intensity of the band was therefore determined. Independently, the isotherms for pyridine adsorption at smooth polycrystalline gold surfaces were obtained using chronocoulometry. The SERS data are compared to the surface concentration coverages and deviate, becoming inverse, above half coverage concentrations. Lastly, the effect of surface roughness on the potential and concentration dependence of pyridine SERS was studied. No correlation between the SERS data from rough electrode surfaces and adsorption isotherms determined at a smooth surface was found. GRA

N91-11926# Rice Univ., Houston, TX. Dept. of Chemistry.
LASER ANNEALING OF SILICON CLUSTERS Interim Technical Report
Shigeo Maruyama (Tokyo Univ., Japan), Lila R. Anderson, and Richard E. Smalley 23 Jul. 1990 12 p Submitted for publication Sponsored in part by Robert A. Welch Foundation
(Contract N00014-88-K-0553)
(AD-A224946; TR-6) Avail: NTIS HC/MF A03 CSCL 07/5

Positive silicon cluster ions prepared by laser vaporization in a supersonic beam and trapped in an ion cyclotron resonance cell were probed in chemisorption reactions with ethylene and ammonia. Clusters in the 36 to 51 atom size range were effectively annealed to unique structural forms by excitation with an XeCl excimer laser followed by cooling through infrared radiation and collisions with argon. GRA

N91-11927# Army Materials Technology Lab., Watertown, MA. Composites Development Branch.
MECHANICAL AND LINEAR VISCOELASTIC PROPERTIES OF HIGH DENSITY POLYETHYLENE OBTAINED FROM TENSILE AND DEAD-LOAD CREEP TESTS Final Report
Albert A. Warnas and Marc S. Pepi Jun. 1990 40 p Sponsored by Army Lab. Command, Adelphi, MD
(AD-A225203; MTL-TR-90-34) Avail: NTIS HC/MF A03 CSCL 07/6

Three grades of high density polyethylene (HDPE) are tested for tensile, creep and creep recovery, and creep properties determination. As a result of tensile tests, the materials were found to strain uniformly under constant strain rate to about 3 percent at 20 C which is well below the 12 percent yield point (YP). With creep tests, an attempt was made to explain and predict the effects of low loads and temperature on linear viscoelasticity (LVE) in these materials. When a creep curve plateaus (zero creep strain after a transient primary creep strain), strain recovery from the plateau is 100 percent. This combination of creep plateau and full recovery as another manifestation and definition of linear viscoelasticity is presented. The effort presented was only partially successful for HDPE as the creep apparatus has an error zone producing uncertain data precisely in the region where HDPE linear viscoelasticity is expected. However, from past research on the same creep apparatus, it was found that amorphous polycarbonate (PC) produces plateaus outside and above this error zone, from which full recovery occurs at strains up to 1 percent and stresses up to approximately 3300 psi (22.75 MPa). GRA

N91-11928# Oak Ridge National Lab., TN. Metals and Ceramic Div.
REINFORCED CERAMICS EMPLOYING DISCONTINUOUS PHASES
Paul F. Becher 1990 8 p Presented at the 2nd International Ceramic Science and Technology Congress Symposium on Glasses for Electronic Applications, Orlando, FL, 13-15 Nov. 1990
(Contract DE-AC05-84OR-21400)
(DE91-000399; CONF-901125-1) Avail: NTIS HC/MF A02

The fracture toughness of ceramics can be improved by the incorporation of a variety of discontinuous reinforcing phases and microstructures. Observations of crack paths in these systems indicate that these reinforcing phases bridge the crack tip wake region. Recent developments in micromechanics toughening models applicable to such systems are discussed and compared with experimental observations. Because material parameters and microstructural characteristics are considered, the crack bridging models provide a means to optimize the toughening effects. DOE

N91-11929# Dayton Univ., OH.
HIGH-TEMPERATURE LUBRICANT ANALYSES USING THE SYSTEM FOR THERMAL DIAGNOSTIC STUDIES (STDS): A FEASIBILITY STUDY Final Report, Jun. 1987 - Mar. 1990
Wayne A. Rubey, Richard C. Striebich, and Debra A. Tirey Jul. 1990 83 p
(Contract F33615-84-C-2411)
(AD-A225242; UDR-TR-87-124; WRDC-TR-90-2047) Avail: NTIS HC/MF A05 CSCL 11/8

Increased importance has been focused upon the development of lubricants which can withstand more intense thermal exposures. Accordingly, a study was undertaken to determine the applicability of experimentally evaluating the high temperature degradation properties of various lubricants using a System for Thermal Diagnostic Studies (STDS). With recent advances in instrumental chemical analysis techniques and associated instrumentation assemblies, it was considered highly probable that improved

measurement and characterization techniques could be implemented for evaluating current and future high performance aircraft lubricants. Therefore, four different lubricant samples were selected and subsequently tested using the STDS, which is an in-line system that performs both the thermal stressing function and the subsequent instrumental chemical analyses. GRA

N91-11930# Ben Gurion Univ. of the Negev, Beersheva (Israel).
PROCEEDINGS OF NETWORKS 90: 10TH POLYMER NETWORKS GROUP MEETING AND 10TH IUPAC INTERNATIONAL SYMPOSIUM ON POLYMER NETWORKS
25 May 1990 201 p Meeting and Symposium held in Jerusalem (Israel), 20-25 May 1990
(Contract DAJA45-90-M-0227)
(AD-A225257; R/D-6429-MS-02) Avail: NTIS HC/MF A10 CSCL 07/6

As an alternative to using statistical mechanical calculation of the free energy of a network, one may go directly to the dynamics of the molecules and derive the dynamical constitutive equation. This has several advantages. There does not need to be separation of microscopic and macroscopic behavior i.e., one can avoid the calculation of a free energy and the subsequent assumption that this free energy can be employed in Navier's equations. In polymer problems this separation is not valid. Transport coefficients have a structure for networks, and this cannot be obtained from static statistical mechanics. The permanent constraints of the network invalidate conventional Gibbs formula and need difficult generalizations such as the replica method. A dynamical approach avoids this. GRA

N91-11931# Colorado State Univ., Fort Collins. Dept. of Chemistry.
MASS AND CHARGE TRANSPORT IN ELECTRONICALLY CONDUCTIVE POLYMERS
Charles R. Martin and Leon S. VanDyke 2 Aug. 1990 42 p
(Contract N00014-82-K-0612)
(AD-A225305; TR-52) Avail: NTIS HC/MF A03 CSCL 07/6

One of the most interesting properties of electronically conductive polymers is their ability to be reversibly switched between electronically insulating and electronically conductive states. A tremendous amount of research effort has been directed, during the last ten years, toward exploring the rates and mechanisms of these switching reactions. Because these reactions are electrochemical, in nature, electrochemical methods were used in these investigations. Both electrochemical and chemical methods for studying insulator/conductor switching processes in electronically conductive polymers are reviewed. GRA

N91-11932# Colorado State Univ., Fort Collins. Dept. of Chemistry.
ELECTROCHEMICAL INVESTIGATIONS OR ELECTRONICALLY CONDUCTIVE POLYMERS. PART 6: MECHANISM OF THE REDOX REACTIONS FOR THE ELECTRONICALLY CONDUCTIVE FORM OF POLYPYRROLE
Zhihua Cai and Charles R. Martin 2 Aug. 1990 41 p
(Contract N00014-82-K-0612)
(AD-A225306; TR-51) Avail: NTIS HC/MF A03 CSCL 07/6

A small amplitude current-step method was developed to study redox reactions of polypyrrole at high doping levels (equilibrium potentials between 0.1 and 0.6 V vs. SCE). The polymer is an electronic conductor in this potential window. It was rigorously proven that both the oxidation and reduction processes of polypyrrole films are purely capacitive in this potential region. The effect of external electrolyte concentration on the film resistance and capacitance was studied. The results suggest that the film ionic conductivity is determined by the concentration of excess free electrolyte inside the film. Charge balancing anions do not contribute to the ionic conductivity. It was also found that the morphology of polypyrrole films is uniform through out the film thickness. Finally, a simple heuristic model is presented for redox reactions of conductive polymers. GRA

N91-11933# Air Force Materials Lab., Wright-Patterson AFB, OH. Polymer Branch.
THE SYNTHESIS OF DECYLOXY SUBSTITUTED AROMATIC POLYAZOMETHINES FOR INCREASED SOLUBILITY Final Report, Dec. 1987 - Dec. 1988
Marilyn R. Unroe and Bruce A. Reinhardt Jun. 1990 31 p
(AF Proj. 2303)
(AD-A225340; WRDC-TR-90-4063) Avail: NTIS HC/MF A03 CSCL 07/3

An aromatic polyazomethine (PAM) was prepared by two routes from 2,5-didecyloxyterephthaldehyde monomer and 1,4-phenylenediamine. The extended chains prepared were comparable in molecular weight to the literature values for previously prepared polyazomethines based on solution viscosity values. However, the PAM polymers prepared exhibited total solubility only in protonating acidic media. GRA

N91-11934# York Univ., Downsview (Ontario). Dept. of Chemistry.
THE SYNTHESIS OF MONOMETALLATED AND UNSYMMETRICALLY SUBSTITUTED BINUCLEAR PHTHALOCYANINES AND A PENTANUCLEAR PHTHALOCYANINE BY SOLUTION AND POLYMER SUPPORT METHODS Technical Report No. 34, Aug. 1989 - Aug. 1990
Clifford C. Leznoff, Polina I. Svirskaya, Ben Khouw, Ronald L. Cerny (Nebraska Univ., Lincoln.), Penny Seymour, and A. B. P. Lever 3 Aug. 1990 49 p Submitted for publication Sponsored in part by Natural Sciences and Engineering Research Council of Canada
(Contract N00014-84-G-0201; NSF CHE-82-11164)
(AD-A225363) Avail: NTIS HC/MF A03 CSCL 07/6

Binuclear phthalocyanines in which two different phthalocyanine nuclei are covalently linked through five-atom bridges, derived from 2-ethyl 2-methyl propan 1,3-diol are prepared. In the examples, one phthalocyanine ring is always substituted with neopentoxy substituents, while the other phthalocyanine ring is unsubstituted or contains a tert-butyl substituents or a neopentoxy substituted copper phthalocyanine, constituting a binuclear phthalocyanine in which only one ring is metallated. The precursor, 2-(2-hydroxymethyl 2-methyl butoxy) 9,16,23-tri neopentoxy phthalocyanine41 was prepared in solution and also by solid phase methods, using polymer-bound trityl chloride derived from a 1 percent divinylbenzene co-styrene co-polymer. GRA

N91-11935# Vrije Univ., Brussels (Belgium).
DURABILITY OF POLYMER BASED COMPOSITE SYSTEMS FOR STRUCTURAL APPLICATIONS. ANALYSIS AND PREDICTIONS
Jun. 1990 16 p Conference held in Brussels, Belgium, 27-31 Aug. 1990
(Grant DAJA89-M-0213)
(AD-A225516; R/D-6183-MS-02) Avail: NTIS HC/MF A03 CSCL 11/4

Most of the new composite systems, based on polymers (materials, structures and adhesive joints) exhibit time effects and their behavior is strongly influenced by temperature moisture absorption and other environmental factors. The use of these materials for structural applications and mechanical loads (static, dynamical and impact type), in a surrounding with varying environmental conditions, needs design procedures. These procedures must take into account this general loading history interacting with the thermomechanical characteristics in order to obtain a reliable prediction of the long term behavior. A valid methodology for life time prediction and/or durability analysis is probably the key element for a larger development of the use of polymer based composite systems in structures in the future.
Dissert. Abstr.

N91-11936# Army Materials Technology Lab., Watertown, MA. Ceramics Research Branch.
STATIC FATIGUE BEHAVIOR OF STRUCTURAL CERAMICS IN A CORROSIVE ENVIRONMENT Final Report
Jeffrey J. Swab and Gary L. Leatherman (Worcester Polytechnic

Inst., MA.) Jun. 1990 24 p
(DA Proj. 1L1-62105-AH-84)
(AD-A225654; MTL-TR-90-32) Avail: NTIS HC/MF A03 CSCL 11/6

Flexure testing was used to determine the effects of sodium sulfate induced corrosion on the static fatigue behavior of several structural ceramics between 800 C and 1200 C. The results showed that the static fatigue behavior of a high purity, full-dense alumina and a Ce-TZP are unaffected by this corrosive environment. However, the static fatigue behavior of a MgO-doped Si3N4 and, to a lesser degree, a Y-TZP are affected by the introduction of sodium sulfate. GRA

N91-11816# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A PHENOMENOLOGICAL MODEL OF COATING/SUBSTRATE ADHESION AND INTERFACIAL BIMETALLIC PEELING STRESS IN COMPOSITE MIRRORS
Paul M. McElroy and Daniel D. Lawson *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 27-34 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11817# Ericsson Radar Electronics A.B., Molndal (Sweden).
METALLISATION METHODS AND APPLICATIONS
D. Joensson *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 35-38 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11832# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Dept. of Structure Mechanics.
INSERT TECHNOLOGY: RE-EVALUATION OF THE POTTING PROCEDURE
U. Rieck and W. Paul *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 131-135 Prepared in cooperation with ERNO Raumfahrttechnik G.m.b.H. (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11841# Societe Nationale de Construction Aeronautique, Gosselies (Belgium).
SIMULATION OF PHYSICO-CHEMICAL PROPERTIES DURING THE CURE OF THERMOSET SYSTEMS
B. Poulaert, J.-L. Coppee, P. Landuyt, and J.-M. Liegeois (Liege Univ., Belgium) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 193-197 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11842# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
PMR 15T: PRELIMINARY CHARACTERIZATION FOR THE MECHANICAL PROPERTIES AND MANUFACTURING
Michel David *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 199-205 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11844# Westland Aerostructures Ltd., East Cowes (England).
THERMOPLASTICS DESIGN DEVELOPMENT CONSIDERATIONS FOR CRYOGENIC TANKS
Jim Scragg *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 213-214 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11846# Fulmer Research Inst. Ltd., Stoke Poges (England).
INTRODUCING AN ADHESIVE BONDING HANDBOOK FOR ADVANCED STRUCTURAL MATERIALS
Josephine Wilson *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 221-224 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11864# Katholieke Univ. te Leuven (Belgium). Dept. of Metallurgy and Materials Engineering.
THERMAL BONDING OF THERMOPLASTIC COMPOSITES: INFLUENCE OF MATRIX AND INTERLAYER ON THE WELD FRACTURE TOUGHNESS
B. Goffaux and I. Verpoest *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 345-350 Sponsored by Belgian Inst. for Scientific Research in Industry and Agriculture (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N91-11937# Rocket Research Corp., Redmond, WA. Aerospace Div.
HYDROXYLAMMONIUM NITRATE COMPATIBILITY TESTS WITH VARIOUS MATERIALS: A LIQUID PROPELLANT STUDY Final Report, Apr. 1989 - Mar. 1990
Eckart W. Schmidt Jul. 1990 115 p Sponsored by Ballistic Research Labs., Aberdeen Proving Ground, MD
(AD-A224594; RRC-90-R-1439; BRL-CR-636) Avail: NTIS HC/MF A06 CSCL 21/9

The compatibility of hydroxylammonium nitrate (HAN), a key ingredient of liquid gun propellants, with 48 different materials of construction was tested in short-term immersion tests in constant temperature baths with observation and measurement of gas evolution. Test temperatures were 298 and 338 K (25 and 65 C). Test duration was 30 days. Materials tested included metals, plastics, ceramics, coatings, and lubricants. At the end of the test, the gas spaces above the solutions were analyzed for gas composition. Evolution of nitrous oxide and nitrogen was evidence of incipient decomposition in the propellant. The off-loaded HAN solutions were analyzed for leached metals. Based on the rate of gas evolution, weight loss of the specimens, discoloration of the liquid, and amount of metals leached, several materials were identified as being incompatible with 60 percent HAN solution. GRA

N91-11938# Wyoming Univ., Laramie. Western Research Inst.
PRODUCTION OF JET FUELS FROM COAL DERIVED LIQUIDS. VOLUME 16: ANALYSIS OF PHENOLIC SPECIES IN COAL DERIVED AVIATION FUELS Interim Report, Sep. 1988 - Jul. 1989
F. D. Guffey and D. E. Hunter Jun. 1990 43 p
(Contract FY1455-86-N-0657; AF Proj. 2480)
(AD-A224656; AFWAL-TR-87-2042-Vol-16) Avail: NTIS HC/MF A03 CSCL 21/4

Samples of jet fuel (JP-4, JP-8, JP-8X) produced from the liquid by-products of the gasification of lignite coal from the Great Plains Gasification Plant were analyzed to determine the quantity and type of organo-oxygen compounds present. Large quantities of oxygen compounds were found in the coal derived liquids and were removed in the refining process. Trace quantities of organo-oxygenate compounds were suspected to be present in the refined fuels. Compounds were identified and quantified as part of an effort to determine the effect of these compounds in fuel instability. GRA

N91-11939# North Dakota Univ., Grand Forks. Energy and Environmental Research Center.
PRODUCTION OF JET FUELS FROM COAL-DERIVED LIQUIDS. VOLUME 14: OXYGENATES CONTENT OF COAL-DERIVED JET FUELS Interim Report, 26 Nov. 1986 - 31 Jul. 1989
Curtis L. Knudson Jun. 1990 61 p
(Contracts FY1455-86-N-0657; DE-AC22-87PC-90016; AF Proj. 2480)
(AD-A224848; AFWAL-TR-87-2042-Vol-14) Avail: NTIS HC/MF A04 CSCL 21/4

Samples of jet fuel (JP-4, JP-8, JP-8X) produced from the liquid by-products of the gasification of lignite coal from the Great Plains Gasification Plant were analyzed to determine the quantity and type of organo-oxygen compounds present. Results were compared to similar fuel samples produced from petroleum. Large quantities of oxygen compounds were found in the coal derived liquids and were removed in the refining process. Trace quantities of organo-oxygenate compounds were suspected to be present in the refined fuels. Compounds were identified and quantified as part of an effort to determine the effect of these compounds in fuel instability. Results of the analysis showed trace levels of phenols, naphthols, benzofurans, hexanol, and hydrogenated naphthols were present in levels below 100 ppm. GRA

N91-11940# Kentucky Univ., Lexington. Dept. of Chemistry.
N-TRIAZOLYBORANES Interim Technical Report
J. Bai and K. Niedenzu Aug. 1990 17 p
(Contract N00014-83-K-0611)
(AD-A224893; UK/DC/TR-29) Avail: NTIS HC/MF A03 CSCL 07/3

The 1,3-dimethyl 2-(N-triazolyl) 1,3,2-diazabor acycloalkanes, (tz)BNCH3(CH2)(n)NCH3 (where Htz = 1,2,3-triazole (1), 1,2,4-triazole (2), benzotriazole (4); n = 2,3) were synthesized by condensation procedures. The resultant species are monomeric and contain three-coordinate boron; they do not dimerize at temperatures as low as -50 C. Compounds of type 1, however, exist as a mixture of the 1- and 2-isomers, whereas 2 and 4 are the 1-isomers exclusively. Only species of type 2 are fluxional at elevated temperatures, those of type 1 and 4 are static up to 80 C. However, the monomeric N-triazolylboranes have remaining Lewis acidity and can complex with additional Htz. Based on this feature, representative bis(1-triazolyl)diorganylborates, Na((tz)2BR2) (Htz = 1,2,4-triazole; R = C2H5 or 1/2 (C8H14) where (C8H14)BH = 9-borabicyclo (3.3.1)nonane), were readily obtained by the reaction of (dimethylamino)diorganylboranes with 1 molar equiv of Htz and subsequent treatment with 1 molar equiv of M(tz) (M = alkali metal). The salts were converted to some representative complexes, e.g., R2B(mu-tz)2Pd(pi-CH2CHCH2). GRA

N91-11941# Ballistic Research Labs., Aberdeen Proving Ground, MD.
BOROHYDRIDE CATALYSIS OF NITRAMINE THERMAL DECOMPOSITION AND COMBUSTION. 3: LITERATURE REVIEW AND WRAP-UP DISCUSSION OF POSSIBLE CHEMICAL MECHANISMS Final Report, Sep. 1987 - Sep. 1988
Michael A. Schroeder Jul. 1990 30 p
(DA Proj. 1L1-61102-AH-43)
(AD-A224918; BRL-TR-3126) Avail: NTIS HC/MF A03 CSCL 19/1

This report is a summary of observations and possible chemical mechanisms for catalysis of the decomposition and combustion of the nitramines HMX and RDX, and of propellants derived from them. Salts containing these anions are reviewed, as is available information on the effects of these salts on decomposition and combustion of HMX and RDX. The emphasis is on thermal decomposition and on salts with alkali metal anions. The pure salts appear stable under vacuum or inert gas to about 700 to 800 C, but there is a report of H2 evolution lower temperatures, ca 300 to 600 C, depending on the nature of the salt. When the salts are heated together with RDX, considerable enhancement of the decomposition rate of RDX is observed; this begins at the melting temperature of pure RDX and becomes intense, leading to a lower, much sharper decomposition exotherm. These observations seem consistent with a catalysis mechanism involving attack of the B-H hydrogens of the catalyst on the nitramine, but it is difficult to evaluate the role of other processes, and of reaction of the catalyst with products. GRA

N91-11942# Flow Research, Inc., Kent, WA.
DEVELOPMENT OF A MATHEMATICAL CODE TO PREDICT THERMAL DEGRADATION OF FUEL AND DEPOSIT FORMATION IN A FUEL SYSTEM Final Report, 15 Aug. 1989 - 15 Apr. 1990
Suresh Menon Sep. 1990 49 p
(Contract F33615-89-C-2932)
(AD-A225415; FRI-TR-502; WRDC-TR-90-2084) Avail: NTIS HC/MF A03 CSCL 21/4

It has been observed in both small-scale experiments and full-scale system simulators that jet fuels, when heated, undergo chemical reactions that eventually result in sediment/deposit formation. Thus, the thermal instability of jet fuels has the deleterious effect of causing fuel system malfunctions. This situation is also possible in supersonic aircraft, where an increase in the metal skin temperature due to aerodynamic heating can, in turn, increase the temperature of uninsulated fuel tanks, leading to deposit formation. Although a great deal of experimental data has been obtained, the exact mechanisms of the degradation reaction and the consequent deposit formation process are still largely unknown. This is primarily due to the fact that the degradation process is influenced by many factors, some of which cannot be determined, varied, or controlled in an experiment. Thus, there is a need for a mathematical model that, once validated, can be used to predict the fuel deposition process by combining the effects of the fluid flow and heat transfer processes and the fuel degradation reactions. GRA

N91-11943# Ballistic Research Labs., Aberdeen Proving Ground, MD.
CONDENSED-PHASE PROCESSES DURING SOLID PROPELLANT COMBUSTION. 1: PRELIMINARY CHEMICAL AND MICROSCOPIC EXAMINATION OF EXTINGUISHED PROPELLANT SAMPLES Progress Report, Sep. 1988 - Sep. 1989
Michael A. Schroder, Robert A. Fifer, Martin S. Miller, and Rose A. Pesce-Rodriguez Jun. 1990 31 p Presented at the 1989 JANNAF Combustion Meeting Submitted for publication
(DA Proj. 1L1-61102-AH-43)
(AD-A225581; BRL-MR-3845) Avail: NTIS HC/MF A03 CSCL 19/1

Burning propellant samples are quenched, and the burned surfaces are examined microscopically and by chemical analysis. Studies are in progress on a series of propellants including XM39, M30, JA2, RDX, HMX, HMX/PU, and HMP/polyester (HMX2) compositions. Preliminary results on quenched samples of XM39 burned at low pressures show evidence of a liquid layer approximately 100 to 300 micron thick. SEM examination reveals little if any evidence of degradation below this liquid layer. GCMS analysis shows that the stabilizer is depleted considerably in the surface layers of quenched samples, presumably by reaction with nitrogen oxides formed by decomposition of RDX and NC. HPLC results show that there is a significant increase the very small amounts possibly present as impurities. GRA

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology.*

N91-11944*# Cincinnati Univ., OH.
AN INVESTIGATION INTO THE FLOW BEHAVIOR OF A SINGLE PHASE GAS SYSTEM AND A TWO PHASE GAS/LIQUID SYSTEM IN NORMAL GRAVITY WITH NONUNIFORM HEATING FROM ABOVE Final Report
Peter J. Disimile and Timothy J. Heist Oct. 1990 36 p (Grant NAG3-938)
(NASA-CR-185304; NAS 1.26:185304) Avail: NTIS HC/MF A03 CSCL 22A

The fluid behavior in normal gravity of a single phase gas system and a two phase gas/liquid system in an enclosed circular cylinder heated suddenly and nonuniformly from above was investigated. Flow visualization was used to obtain qualitative data on both systems. The use of thermochromatic liquid crystal particles as liquid phase flow tracers was evaluated as a possible means of simultaneously gathering both flow pattern and temperature gradient data for the two phase system. The results of the flow visualization experiments performed on both systems can be used to gain a better understanding of the behavior of such systems in a reduced gravity environment and aid in the verification of a numerical model of the system. Author

N91-12404*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
IMPLICATIONS OF ACCELERATION ENVIRONMENTS ON SCALING MATERIALS PROCESSING IN SPACE TO PRODUCTION
Ken Demel *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 34 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22A

N91-12406*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
MICROGRAVITY AND ITS EFFECTS ON RESIDUAL MOTIONS IN FLUIDS
J. Iwan D. Alexander and Charles A. Lundquist (Alabama Univ., Huntsville.) *In its* Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 11 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22A

N91-12407*# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.).
THE MICROGRAVITY ENVIRONMENT OF THE D1 MISSION
H. Hamacher, U. Merbold (European Space Agency, Paris, France), and R. Jilg *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 24 p Previously announced in IAA as A87-15978 (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22A

N91-12408*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
LOW-g MEASUREMENTS BY NASA
Roger P. Chassay and Arthur Schwaniger *In its* Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 48 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22A

N91-12409*# Draper (Charles Stark) Lab., Inc., Cambridge, MA.
PREDICTION AND RECONSTRUCTION OF ON-ORBIT ACCELERATION
Edward Bergmann *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 16 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22A

N91-12410*# BGB, Inc., Huntsville, AL.
SPACELAB-3 LOW-g ACCELEROMETER DATA FROM THE FLUID EXPERIMENTS SYSTEM (FES)
Gary Arnett *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 46 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22A

N91-12420*# EFFORT, Inc., Houston, TX.
FREE-FLOATING EXPERIMENTS IN ORBITER AND SPACE STATION Abstract Only
Owen K. Garriott *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 2 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22A

N91-12421*# Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.).
MICROGRAVITY ACCELERATION MODELING FOR ORBITAL SYSTEMS Abstract Only
Walter Knabe and Charles R. Baugher, ed. (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.) *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 1 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22A

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N91-11945*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PLASMA-ASSISTED PHYSICAL VAPOR DEPOSITION SURFACE TREATMENTS FOR TRIBOLOGICAL CONTROL
Talivaldis Spalvins 1990 18 p Presented at the TMS Annual Meeting, New Orleans, LA, 17-21 Feb. 1991; sponsored in part by the Minerals, Metals and Materials Society
(NASA-TM-103652; E-5799; NAS 1.15:103652) Avail: NTIS HC/MF A03 CSCL 13B

In any mechanical or engineering system where contacting surfaces are in relative motion, adhesion, wear, and friction affect reliability and performance. With the advancement of space age transportation systems, the tribological requirements have dramatically increased. This is due to the optimized design, precision tolerance requirements, and high reliability expected for solid lubricating films in order to withstand hostile operating conditions (vacuum, high-low temperatures, high loads, and space radiation). For these problem areas the ion-assisted deposition/modification processes (plasma-based and ion beam techniques) offer the greatest potential for the synthesis of thin films and the tailoring of adherence and chemical and structural properties for optimized tribological performance. The present practices and new approaches of applying soft solid lubricant and hard wear resistant films to engineering substrates are reviewed. The ion bombardment treatments have increased film adherence, lowered friction coefficients, and enhanced wear life of the solid lubricating films such as the dichalcogenides (MoS2) and the soft metals (Au, Ag, Pb). Currently, sputtering is the preferred method of applying MoS2 films; and ion plating, the soft metallic films. Ultralow friction coefficients (less than 0.01) were achieved with sputtered MoS2. Further, new diamond-like carbon and BN lubricating films are being developed by using the ion assisted deposition techniques. Author

N91-11946# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
CONTROL OF A MAINTENANCE SYSTEM WHEN FAILURE AND REPAIR TIMES HAVE PHASE TYPE DISTRIBUTIONS M.S. Thesis [CONTROLE DE UM SISTEMA DE MANUTENCAO QUANDO OS TEMPOS DE FALHA E REPARO TEM DISTRIBUICAO DO TIPO FASE]
Rita deCassiaMenesesRodrigues Sep. 1990 120 p In PORTUGUESE; ENGLISH summary
(INPE-5104-TDL/418) Avail: NTIS HC/MF A06

In the model of machine repair discussed there are M + R identical machines, M operating, and R spares. All machines are independent of one another. When an operating machine fails, it is sent to a single server repair station and immediately replaced by a spare machine, if one is available. The server has two available service types to choose from. There are waiting costs, repair costs, lost production costs, and switch-over costs. The following decision problem is treated: to obtain a stationary policy which determines the service type as a function of the state of the system in order to minimize the long-run average cost when failure and repair times have second-order Coxian distribution. This control problem is represented by a semi-Markov decision process. The policy-iteration algorithm and the value-iteration algorithm are used to obtain the optimal policy. Numerical results are given for these two optimization methods. Author

N91-11947# Acurex Corp., Mountain View, CA. Environmental Systems Div.
USERS GUIDE FOR THE CONVERSION OF NAVY PAINT SPRAY BOOTH PARTICULATE EMISSION CONTROL SYSTEMS FROM WET TO DRY OPERATION Final Report, Jan. - Sep. 1989
Jacqueline Ayer and Darrel Tate Jun. 1990 95 p Sponsored by Naval Civil Engineering Lab., Port Hueneme, CA and EPA, Research Triangle Park, NC
(AD-A224737; NCEL-CR-90.005) Avail: NTIS HC/MF A05 CSCL 11/3

Users are provided instructions and cost evaluation information for converting the water curtain particulate emission control system currently used on many Navy painting facilities to dry filter operation. Engineering and logistical issues are addressed, and example design plans are provided. Construction and operating permit requirements mandated by regulatory agencies, such as air pollution control districts and fire departments, are discussed. Cost estimates that may be used to perform comprehensive cost evaluation analyses are provided. In addition, sample calculations that illustrate how to use the cost data are included. GRA

N91-11948# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
CALCULATION OF CONTAINMENT CONCENTRATIONS WHILE COATING THE INTERIOR OF A BULK STORAGE FUEL TANK M.S. Thesis
Gail Maureen Haberlin May 1990 219 p
(Contract N00123-89-G-0587)
(AD-A224930) Avail: NTIS HC/MF A10 CSCL 24/1

In the last decade we, as a society, have made great strides in the field of Occupational Safety and Health. The smarter we become about the hazards that surround us the more we need to learn. It is not enough to know that a substance provides a potential risk to an individual but we need to know what that risk is; specifically in a particular occupational activity, when does exposure to a chemical become hazardous and what are the effects of the exposure. Air quality may be defined as the characteristics of air that affect an individual's health and well-being in a salubrious way. More technically, air quality is a quantitative indicator of how well air satisfies the requirements for human occupancy: thermal acceptability; normal concentrations of respiratory gases (i.e., oxygen, nitrogen and carbon dioxide); and suppression of other contaminants below levels that are deleterious to health or produce unpleasant odors. GRA

N91-11949# Universiteit Twente, Enschede (Netherlands).
MICROFILTRATION: MEMBRANE DEVELOPMENT AND MODULE DESIGN Ph.D. Thesis
Hendrik Dirk Willem Roesink 1989 195 p Sponsored by Netherlands Ministry of Economic Affairs and X-FLOW B.V., Enschede, Netherlands
(ISBN-90-9002843-9; ETN-90-97766) Copyright Avail: NTIS HC/MF A09

The development of a type of hydrophilic microfiltration membranes is described. Studies which may result in a design of microfiltration modules containing capillary membranes are presented. The membranes are prepared from a solution containing two polymers and are of flat or cylindrical geometry. Attention is focused an capillary membranes, which are tubular membranes of outer diameter 0.5 to 5 mm, prepared by means of a dry-wet spining process. Different flow conditions of the feed suspension in the modules are described. The most favorable configuration appears to be transverse flow. A model to calculate the pressure drop in the bore of the capillary membrane during filtration and backflushing is presented. ESA

N91-11950# Naval Research Lab., Washington, DC.
MANUAL FIRE SUPPRESSION METHODS ON TYPICAL MACHINERY SPACE SPRAY FIRES Interim Report
H. W. Carhart, J. T. Leonard, E. K. Budnick, R. J. Ouellette, and J. H. Shanley, Jr. 31 Jul. 1990 130 p Prepared in cooperation with Hughes Associates, Inc., Wheaton, MD
(AD-A225311; NRL-MR-6673) Avail: NTIS HC/MF A07 CSCL 13/12

A series of tests was conducted to evaluate the effectiveness of Aqueous Film Forming Foam (AFFF), potassium bicarbonate powder (PKP) and Halon 1211, alone and in various combinations, in extinguishing spray fires. The sprays were generated by JP-5 jet fuel issuing from an open sounding tube, and open petcock, a leaking flange or a slit pipe, and contacting an ignition source. The results indicate that typical fuel spray fires, such as those simulated in this series, are very severe. Flame heights ranged from 6.1 m (20 ft) for the split pipe to 15.2 m (50 ft) for the sounding tube scenario. These large flame geometries were accompanied by heat release rates of 6 MW to greater than 50 MW, and hazardous thermal radiation levels in the near field environment, up to 9.1 m (30 ft) away. Successful suppression of these fires requires both a significant reduction in flame radiation and delivery of a suppression agent to shielded areas. Of the nine suppression methods tested, the 95 gpm AFFF hand line and the hand line in conjunction with PKP were particularly effective in reducing the radiant flux. GRA

N91-11951# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
MANUFACTURE AND MEASUREMENT OF LOW LOSS AND LOW SCATTER MIRRORS Ph.D. Thesis - Tech. Univ. Brunswick
Dirk-Roger Schmitt Aug. 1990 185 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1239)
(DLR-FB-90-19; ISSN-0171-1342; ETN-90-98042) Copyright Avail: NTIS HC/MF A09; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 68 Deutsche marks

All necessary steps for the manufacturing of laser gyroscope mirrors are investigated, including the development of superpolished substrates and the optimization of processes to obtain low absorption layer systems. Micron bumps under 0.1 mm were observed at the substrates with a differential interference contrast process. Several dielectric layer systems were examined: TiO2/SiO2 in relation with Ag, Ta2O5/SiO2 and PrTiO3/SiO2. With these materials reflectivities higher than 0.995 were obtained. The lowest value for the scattering was reached with the PrTiO3/SiO2 system. The strong spectral variation of the reflection and transmission power of the layer systems was used for the development of edge filters for optical modulators on a GaAs basis. ESA

N91-11952# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Dienstleistungsbereich.
THE MECHANISM OF ELECTROCHEMICAL AND ANISOTROPIC SILICON ETCHING AND ITS APPLICATIONS
Helmut Seidel 1989 19 p Presented at 3rd Togota Conference, Aichi-Ken, Japan, 22-25 Oct. 1989
(MBB-Z-0190-89-PUB; ETN-90-98146) Avail: NTIS HC/MF A03

An attempt to provide a general unifying model for all alkaline anisotropic silicon etchants is presented. The latter is a key technology in micromechanical device fabrication, and several aspects regarding this application are discussed. The three main properties of anisotropic silicon etching, dependence of the etch rate on the crystal direction, the dopant concentration and on an externally applied electric potential, are explained. Experiments and results are described. ESA

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N91-11953*# Hawaii Univ., Manoa. Dept. of Electrical Engineering.
MULTI-LEVEL MODULATION CODES AND MULTI-STAGE DECODING
Shu Lin 28 Feb. 1990 38 p
(Grant NAG5-931)
(NASA-CR-186376; NAS 1.26:186376; NASA-90-002) Avail: NTIS HC/MF A03 CSCL 17B

Multi-level method is a powerful technique for constructing bandwidth efficient modulation codes. It allows the construction of modulation codes systematically with arbitrary large minimum squared Euclidean distance from component codes in conjunction with proper bits-to-signal mapping. If the component codes are chosen properly, the resultant modulation code not only has good minimum squared Euclidean distance but is also rich in structural properties such as: linear structure, phase invariant property, and trellis structure. A modulation code with linear structure has invariant distance distribution. Phase invariant property is useful in resolving carrier-phase ambiguity and ensuring rapid carrier-phase resynchronization after temporary loss of synchronization. It the component codes have trellis structure, the resultant multi-level modulation code also has trellis structure. Trellis structure allows decoding of a multi-level modulation code with the soft-decision Viterbi decoding algorithm. Furthermore, the multi-level structure allows decoding of a multi-level modulation code with the multi-stage decoding. This type of decoding reduces the decoding complexity. Multi-stage decoding is not optimum even though the decoding of each component is optimum. Based on the analysis and simulation results, the difference in error performance between the optimum decoding of the overall multi-level modulation code and the suboptimum multi-stage decoding of the code is very little, a fraction of dB loss. Author

N91-11954*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROCEEDINGS OF THE FOURTEENTH NASA PROPAGATION EXPERIMENTERS MEETING (NAPEX 14) AND THE ADVANCED COMMUNICATIONS TECHNOLOGY SATELLITE (ACTS) PROPAGATION STUDIES MINIWORKSHOP
Faramaz Davarian, ed. 1 Jul. 1990 258 p Workshop held in Austin, TX, 11-12 May 1990
(Contract NAS7-918)
(NASA-CR-186974; JPL-Publ-90-27; NAS 1.26:186974) Avail: NTIS HC/MF A12 CSCL 20N

The NASA Propagation Experimenters Meeting (NAPEX), supported by the NASA Propagation Program, is convened annually to discuss studies made on radio wave propagation by investigators from domestic and international organizations. NAPEX XIV was held on May 11, 1990, at the Balcones Research Centers, University of Texas, Austin, Texas. The meeting was organized into two technical sessions: Satellite (ACTS) and the Olympus Spacecraft, while the second focused on the fixed and mobile satellite propagation studies and experiments. Following NAPEX XIV, the ACTS Miniworkshop was held at the Hotel Driskill, Austin, Texas, on May 12, 1990, to review ACTS propagation activities since the First ACTS Propagation Studies Workshop was held in Santa Monica, California, on November 28 and 29, 1989. For individual titles, see N91-11955 through N91-11972.

N91-11955*# Communications Satellite Corp., Clarksburg, MD.
SUMMARY OF THE FIRST ACTS PROPAGATION WORKSHOP
David V. Rogers *In* JPL, California Inst. of Tech., Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 17-22 (For primary document see N91-11954 03-32)
Avail: NTIS HC/MF A12 CSCL 20N

The first Advanced Communications Technology Satellite (ACTS) Propagation Studies Workshop (APSW I), organized by NASA/Jet Propulsion Laboratory (JPL) to plan propagation experiments and studies with NASA's ACTS, convened in Santa Monica, California, during November 28 and 29, 1989. The objectives of APSW I were to identify general and ACTS-related propagation needs, and to prepare recommendations for a study plan incorporating scientific and systems requirements related to deployment of 8 to 10 propagation terminals in the USA in support of ACTS experimental activities. A summary of workshop activities is given. Author

N91-11956*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ACTS PROPAGATION PROGRAM
Faramaz Davarian *In its* Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 23-28 (For primary document see N91-11954 03-32)
Avail: NTIS HC/MF A12 CSCL 20N

The Advanced Communications Technology Satellite (ACTS) Propagation Program is organized to fulfill certain needs and requirements of the ACTS community. It is hoped that issues related to propagation effects in the context of ACTS experiments can be addressed and resolved by this program. The objectives of the ACTS Propagation Program are included in but not limited to planning for propagation measurements and studies using ACTS; organizing propagation experimenters who want to use ACTS into one group; developing observation stations for ACTS propagation measurements; supervising data collection, analysis, and ensure uniformity of data recording among various experimenters; and assisting the ACTS Program Office to carry out its objectives. This program is organized and managed by the NASA Propagation Program at the Jet Propulsion Laboratory. Financial support for this program is provided by NASA. Author

N91-11957*# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
OPEX PROPAGATION MEASUREMENTS AND STUDIES
Bertram Arbesser-Rastburg *In* JPL, California Inst. of Tech., Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 29-35 (For primary document see N91-11954 03-32)
Avail: NTIS HC/MF A12 CSCL 20N

With the launch of the telecommunications Olympus satellite a new area began for the Olympus Propagation Experiments (OPEX) group. The years of preparations are now paying off - the experiments are underway and the co-operative effort is now turning

its attention to the processing and analysis of data and to the interpretation of results. The aim here is to give a short review of the accomplishments made since NAPEX 13 and the work planned for the future. When ESA's Olympus was launched in summer of 1989 it carried a payload producing three unmodulated beacons at 12.5, 19.8, and 29.7 GHz. The main purpose of these beacons is to enable scientists to carry out long term slant path propagation experiments at these frequencies. The OPEX group, which was set up under ESA auspices in 1980, had been preparing for this event very carefully. The specifications for the equipment to be used and the elaboration of standard procedures for data processing and analysis have been worked out jointly. Today the OPEX community includes approximately 30 groups of experimenters. Immediately after achieving platform stability at the orbital location at 341 degrees east, ESA performed the In-Orbit Tests. Most measurements were carried out in Belgium using terminals specially developed for this purpose. A summary of the test results is given. Author

N91-11958*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Satellite Communications Group.
OLYMPUS PROPAGATION STUDIES IN THE US: PROPAGATION TERMINAL HARDWARE AND EXPERIMENTS
Warren L. Stutzmzn *In* JPL, California Inst. of Tech., Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 36-42 (For primary document see N91-11954 03-32)
Avail: NTIS HC/MF A12 CSCL 20N

Virginia Tech is performing a comprehensive set of propagation measurements using the Olympus satellite beacons at 12.5, 20, and 30 GHz. These data will be used to characterize propagation conditions on small earth terminal (VSAT)-type networks for next generation small aperture Ka-band systems. The European Space Agency (ESA) satellite Olympus was launched July 12, 1989. The spacecraft contains a sophisticated package of propagation beacons operating at 12.5, 19.77, and 29.66 GHz (referred to as 12.5, 20, and 30 beacons). These beacons cover the east coast of the United States with sufficient power for attenuation measurements. The Virginia Satellite Communications Group is completing the hardware construction phase and will begin formal data collection in June. Author

N91-11959*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Satellite Communications Group.
OLYMPUS PROPAGATION STUDIES IN THE US: RECEIVER DEVELOPMENT AND THE DATA ACQUISITION SYSTEM
John C. McKeeman *In* JPL, California Inst. of Tech., Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 43-53 (For primary document see N91-11954 03-32)
Avail: NTIS HC/MF A12 CSCL 20N

Virginia Tech has developed two types of receivers to monitor the Olympus beacons, as well as a custom data acquisition system to store and display propagation data. Each of the receiver designs uses new hybrid analog/digital techniques. The data acquisition system uses a stand alone processor to collect and format the data for display and subsequent processing. The launch of the Olympus satellite with its coherent beacons offers new opportunities to study propagation effects at 12.5, 20, and 30 GHz. At Virginia Tech, the satellite is at 14 degrees in elevation, which allows us to measure low elevation angle effects. However, to make these measurements, a very accurate and stable measurement system is required. Virginia Tech has constructed a complex receiving system which monitors the Olympus beacons and all parameters associated with propagation research. In the current configuration, researchers have developed a receiver which frequency locks to the less fade susceptible 12.5 GHz beacon. Since all beacons on the satellite are driven from a single master oscillator, drift in the 12.5 GHz beacon implies corresponding drifts in the 20, and 30 GHz beacons. The receivers for the 20 and 30 GHz systems derive their frequency locking information from the 12.5 GHz system. This widens the dynamic range of the receivers and allows the receivers to maintain lock in severe fade conditions. In addition to monitoring the beacons, the sky noise is monitored with radiometers at each frequency. The radiometer output is used to set the clear air level for each beacon measurement. Researchers also measure the rain rate with several tipping bucket rain gauges placed along the propagation path. Author

N91-11960*# Michigan Technological Univ., Houghton. Sensing and Signal Processing Lab.
OLYMPUS RECEIVER EVALUATION AND PHASE NOISE MEASUREMENTS
Richard L. Campbell, Huailiang Wang, and Dennis Sweeney (Virginia Polytechnic Inst. and State Univ., Blacksburg.) *In* JPL, California Inst. of Tech., Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 54-73 (For primary document see N91-11954 03-32)
Avail: NTIS HC/MF A12 CSCL 20N

A set of measurements performed by the Michigan Tech Sensing and Signal Processing Group on the analog receiver built by the Virginia Polytechnic Institute (VPI) and the Jet Propulsion Laboratory (JPL) for propagation measurements using the Olympus Satellite is described. Measurements of local oscillator (LO) phase noise were performed for all of the LOs supplied by JPL. In order to obtain the most useful set of measurements, LO phase noise measurements were made using the complete VPI receiver front end. This set of measurements demonstrates the performance of the receiver from the Radio Frequency (RF) input through the high Intermediate Frequency (IF) output. Three different measurements were made: LO phase noise with DC on the voltage controlled crystal oscillator (VCXO) port; LO phase noise with the 11.381 GHz LO locked to the reference signal generator; and a reference measurement with the JPL LOs out of the system. Author

N91-11961*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
EXPERIMENTS FOR Ka-BAND MOBILE APPLICATIONS: THE ACTS MOBILE TERMINAL
Polly Estabrook, Khaled Dessouky, and Thomas Jedrey *In its* Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 74-82 (For primary document see N91-11954 03-32)
Avail: NTIS HC/MF A12 CSCL 20N

To explore the potential of Ka-band to support mobile satellite services, the Jet Propulsion Laboratory (JPL) has initiated the design and development of a Ka-band land-mobile terminal to be used with the Advanced Communications Technology Satellite (ACTS). The planned experimental setup with ACTS is described. Brief functional descriptions of the mobile and fixed terminals are provided. The inputs required from the propagation community to support the design activities and the planned experiments are also discussed. Author

N91-11962*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DEEP SPACE PROPAGATION EXPERIMENTS AT Ka-BAND
Stanley A. Butman *In its* Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 85-101 (For primary document see N91-11954 03-32)
Avail: NTIS HC/MF A12 CSCL 20N

Propagation experiments as essential components of the general plan to develop an operational deep space telecommunications and navigation capability at Ka-band (32 to 35 GHz) by the end of the 20th century are discussed. Significant benefits of Ka-band over the current deep space standard X-band (8.4 GHz) are an improvement of 4 to 10 dB in telemetry capacity

and a similar increase in radio navigation accuracy. Propagation experiments are planned on the Mars Observer Mission in 1992 in preparation for the Cassini Mission to Saturn in 1996, which will use Ka-band in the search for gravity waves as well as to enhance telemetry and navigation at Saturn in 2002. Subsequent uses of Ka-band are planned for the Solar Probe Mission and the Mars Program. Author

N91-11963*# National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.

ATTENUATION STATISTICS DERIVED FROM EMISSION MEASUREMENTS BY A NETWORK OF GROUND-BASED MICROWAVE RADIOMETERS

E. R. Westwater, J. B. Snider, M. J. Falls, and E. Fionda (Fondazione Ugo Bordoni, Rome, Italy) *In* JPL, California Inst. of Tech., Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 102-109 (For primary document see N91-11954 03-32)

Avail: NTIS HC/MF A12 CSCL 20N

Two seasons of thermal emission measurements, running from December 1987 through February 1988 and from June through August 1988 of thermal emission measurements, taken by a multi-channel, ground-based microwave radiometer, are used to derive single-station zenith attenuation statistics at 20.6 and 31.65 GHz. For the summer period, statistics are also derived for 52.85 GHz. In addition, data from two dual-channel radiometers, separated from Denver by baseline distances of 49 and 168 km, are used to derive two-station attenuation diversity statistics at 20.6 and 31.65 GHz. The multi-channel radiometer is operated at Denver, Colorado; the dual-channel devices are operated at Platteville and Flagler, Colorado. The diversity statistics are presented by cumulative distributions of maximum and minimum attenuation. Author

N91-11964*# Texas Univ., Austin. Electrical Engineering Research Lab.

SATELLITE SOUND BROADCAST PROPAGATION STUDIES AND MEASUREMENTS

Wolfhard J. Vogel and Geoffrey W. Torrence *In* JPL, California Inst. of Tech., Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 110-123 (For primary document see N91-11954 03-32)

Avail: NTIS HC/MF A12 CSCL 20N

Satellite Sound Broadcasting is an attractive satellite application. Before regulatory decisions can be made in 1992, the propagation effects encountered have to be characterized. The Electrical Engineering Research Laboratory has nearly completed a system which will allow amplitude measurements to be made over 10 MHz bandwidths in the 800 to 1800 MHz frequency range. The system uses transmission from a transportable tower, and reception inside buildings or in the shadow of trees or utility poles. The goal is to derive propagation models for use by systems engineers who are about to design satellite broadcast systems. The advance of fiber-optics technology has helped to focus future development of satellite services into areas where satellites are uniquely competitive. One of these preferred satellite applications is the broadcasting of high-quality sound for stationary or mobile reception by listeners using low-cost, consumer-grade receivers. Before such services can be provided, however, the political hurdles of spectrum allocation have to be surmounted and the technical questions of standardization for world-wide compatibility have to be resolved. In order to arrive at an optimal system design, efficient in the use of our scarce spectral resources, affordable both to the broadcaster and the listener, and providing predictable performance, the propagation effects to which the service is subjected have to be characterized. Consequently, the objective of the research project is to make basic propagation measurements for direct Satellite Sound Broadcasting Service (SSBS). The data obtained should allow the development of propagation models to be used by communications engineers designing the operational systems. Such models shall describe the effects of shadowing and multipath propagation on SSBS receivers operating in a specified environment, such as inside commercial or residential buildings of various construction and also in the shadow of trees or utility poles as might be encountered by transporting or mobile listeners. Author

N91-11965*# Ministry of Posts and Telecommunications, Ibaraki (Japan).

SATELLITE SOUND BROADCAST RESEARCH ASPECT IN CRL

Yoshihiro Hase, Kimio Kondo, and Shingo Ohmori *In* JPL, California Inst. of Tech., Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 118-123 (For primary document see N91-11954 03-32)

Avail: NTIS HC/MF A12 CSCL 20N

Researches on Satellite Sound Broadcasting Services (SSBS) have become active in the past few years. Activities of the Consultative Committee for International Radio (CCIR) and the World Administrative Radio Conference (WARC), especially about digital systems proposed in the CCIR report, are briefly reviewed. The Communications Research Laboratory (CRL) future plan of SSBS research, stressing propagation rather than communications aspects, is described. Author

N91-11966*# Johns Hopkins Univ., Laurel, MD.

A DESCRIPTION OF RESULTS FROM THE HANDBOOK ON SIGNAL FADE DEGRADATION FOR THE LAND MOBILE SATELLITE SERVICE

Julius Goldhirsh and Wolfhard J. Vogel (Texas Univ., Austin.) *In* JPL, California Inst. of Tech., Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 124-131 (For primary document see N91-11954 03-32)

Avail: NTIS HC/MF A12 CSCL 20N

During the period 1983 to 1988 a series of experiments were undertaken by the Electrical Engineering Research Laboratory of the University of Texas and the Applied Physics Laboratory of the Johns Hopkins University in which propagation impairment effects were investigated for the Land Mobile Satellite Service (LMSS). The results of these efforts have appeared in a number of publications, technical reports, and conference proceedings. The rationale for the development of a 'handbook' was to locate the salient and useful results in one single document for use by communications engineers, designers of planned LMSS communications systems, and modelers of propagation effects. Where applicable, the authors have also drawn from the results of other related investigations. A description of sample results contained in this handbook which should be available in the latter part of 1990 is given. Author

N91-11967*# Colorado Univ., Boulder.

CODELESS GPS APPLICATIONS TO MULTI-PATH: CGAMP

P. F. MacDoran, R. B. Miller, D. Jenkins, J. Lemmon (Institute for Telecommunication Sciences, Boulder, CO.), K. Gold, W. Schreiner, and G. Snyder *In* JPL, California Inst. of Tech.,Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 132-139 (For primary document see N91-11954 03-32)

Avail: NTIS HC/MF A12 CSCL 20N

Cordless Global Positioning System (GPS) Applications to Multi-Path (CGAMP) is meeting the challenge of exploiting the L-band signals from the Global Positioning System (GPS) satellites for the measurement of the impulse response of radio transmission channels over space-Earth paths. This approach was originally suggested by E. K. Smith and has been pursued by J. Lemmon, without an affordable implementation being identifiable. In addition to the high cost of a suitable P code correlating GPS receiver,

there is also the major impediment of the often announced Department of Defense policy of selective availability/anti-spoof (SA/AS) that clouds reliable access to the wideband (20 MHz) P channel of the GPS signals without cryptographic access. A technique proposed by MacDoran utilizes codeless methods for exploiting the P channel signals implemented by the use of a pair of antennas and cross correlation signal detection. Author

N91-11968*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
LAND-MOBILE FIELD EXPERIMENTS IN AUSTRALIA
Loretta G. L. Ho and Khaled Dessouky *In its* Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 140-147 (For primary document see N91-11954 03-32)
Avail: NTIS HC/MF A12 CSCL 20N

The Mobile Satellite Experiment/Australia Mobile Satellite Experiment (MSAT-X/AUSSAT) experiment offered the first true land-mobile satellite configuration to evaluate the MSAT-X technologies and equipment. Both quantitative data tests and qualitative voice link demonstrations were successfully conducted. From the collected data, system performance in typical land-mobile conditions was extracted. A set of propagation characteristics corresponding to the wide range of environments encountered was also obtained. A brief description is given of the MSAT-X/AUSSAT experiment and a summary of its results analyzed to date. Author

N91-11969*# Colorado Univ., Boulder. Dept. of Electrical and Computer Engineering.
NASA PROPAGATION INFORMATION CENTER
Ernest K. Smith and Warren L. Flock *In* JPL, California Inst. of Tech., Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 148-149 Previously announced as N90-17946 (For primary document see N91-11954 03-32)
Avail: NTIS HC/MF A12 CSCL 20N

The NASA Propagation Information Center became formally operational in July 1988. It is located in the Department of Electrical and Computer Engineering of the University of Colorado at Boulder. The center is several things: a communications medium for the propagation with the outside world, a mechanism for internal communication within the program, and an aid to management. Author

N91-11970*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ACTS PROPAGATION TERMINAL PROTOTYPE PLANNING AND DESIGN
Faramaz Davarian, F. Pergal, D. Chakraborty, and Warren L. Stutzman (Virginia Polytechnic Inst. and State Univ., Blacksburg.) *In its* Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 178-202 (For primary document see N91-11954 03-32)
Avail: NTIS HC/MF A12 CSCL 20N

The planning and design of a prototype propagation receiving terminal for beacon signals at 27 and 20 GHz bands are examined. The developmental plan is discussed, followed by technical design considerations including, the Advanced Communications Technology Satellite (ACTS) system salient features and frequency plan, beacon signal parameters and specifications, system calculations, and terminal hardware design issues. Author

N91-11971*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
LBR-2 EARTH STATIONS FOR THE ACTS PROGRAM
Michael OReilly (Harris Corp., Melbourne, FL.), Russell Jirberg, and Ernie Spisz *In* JPL, California Inst. of Tech., Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 232-239 (For primary document see N91-11954 03-32)
Avail: NTIS HC/MF A12 CSCL 20N

The Low Burst Rate-2 (LBR-2) earth station being developed for NASA's Advanced Communications Technology Satellite (ACTS) is described. The LBR-2 is one of two earth station types that operate through the satellite's baseband processor. The LBR-2 is a small earth terminal (VSAT)-like earth station that is easily sited on a user's premises, and provides up to 1.792 megabits per second (MBPS) of voice, video, and data communications. Addressed here is the design of the antenna, the rf subsystems, the digital processing equipment, and the user interface equipment. Author

N91-11972*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A REVIEW OF FADE DETECTION TECHNIQUES
F. J. Pergal *In its* Proceedings of the Fourteenth NASA Propagation Experimenters Meeting (NAPEX 14) and the Advanced Communications Technology Satellite (ACTS) Propagation Studies Miniworkshop 1 Jul. 1990 p 240-252 (For primary document see N91-11954 03-32)
Avail: NTIS HC/MF A12 CSCL 20N

Several proposed propagation fade detection techniques are reviewed in light of general requirements presented for beacon fade characterization. The discussion includes an analysis of phase lock versus frequency lock beacon tracking loops and of excess noise injection type radiometers. The Advanced Communications Technology Satellite (ACTS) beacon fade detection schemes proposed by the Communications Satellite Corporation and the Jet Propulsion Laboratory are examined along with the fade detection technique used by Harris in the Advanced Communications Technology Satellite (ACTS) low burst rate (LBR) terminal. Author

N91-11973*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE TELECOMMUNICATIONS AND DATA ACQUISITION REPORT Progress Report, Apr. - Jun. 1990
E. C. Posner, ed. 15 Aug. 1990 169 p
(NASA-CR-186995; JPL-TDA-PR-42-102; NAS 1.26:186995)
Avail: NTIS HC/MF A08 CSCL 17B

Archival reports on developments in programs managed by the Jet Propulsion Laboratory's (JPL) Office of Telecommunications and Data Acquisition (TDA) are given. Space communications, radio navigation, radio science, and ground-based radio and radar astronomy, activities of the Deep Space Network (DSN) and its associated Ground Communications Facility (GCF) in planning, supporting research and technology, implementation, and operations are reported. Also included is TDA-funded activity at JPL on data and information systems and reimbursable Deep Space Network (DSN) work performed for other space agencies through NASA. For individual titles, see N91-11974 through N91-11985.

N91-11974*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Tracking Systems and Applications Section.
THE FIRST GEOCENTER ESTIMATION RESULTS USING GPS MEASUREMENTS **c43**
R. P. Malla (Sterling Software, Pasadena, CA.) and S. C. Wu *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 1-9 (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 08E

The center of mass of the Earth is the natural and unambiguous origin of a geocentric satellite dynamical system. A geocentric reference frame assumes that the origin of its coordinate axes is at the geocenter, in which all relevant observations and results can be referred and in which geodynamic theories or models for the dynamic behavior of Earth can be formulated. In practice, however, a kinematically obtained terrestrial reference frame may assume an origin other than the geocenter. A fast and accurate

method of determining origin offset from the geocenter is highly desirable. Global Positioning System (GPS) measurements, because of their abundance and broad distribution, provide a powerful tool to obtain this origin offset in a short period of time. Two effective strategies have been devised. Data from the first Central and South America (Casa Uno) global GPS experiment were studied to demonstrate the ability of recovering the geocenter location with present-day GPS satellites and receivers. Author

N91-11975*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
COMPUTER SIMULATIONS OF IONS IN RADIO-FREQUENCY TRAPS
A. Williams, J. D. Prestage, L. Maleki, J. Djomehri, and E. Harabetian *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 10-26 (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 17B

The motion of ions in a trapped-ion frequency standard affects the stability of the standard. In order to study the motion and structures of large ion clouds in a radio-frequency (RF) trap, a computer simulation of the system that incorporates the effect of thermal excitation of the ions was developed. Results are presented from the simulation for cloud sizes up to 512 ions, emphasizing cloud structures in the low-temperature regime. Author

N91-11976*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
DESIGN OF A FIBER-OPTIC TRANSMITTER FOR MICROWAVE ANALOG TRANSMISSION WITH HIGH PHASE STABILITY **c74**
R. T. Logan, Jr., G. F. Lutes, L. E. Primas, and L. Maleki *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 27-33 Sponsored in part by RADC (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 20F

The principal considerations in the design of fiber-optic transmitters for highly phase-stable radio frequency and microwave analog transmission are discussed. Criteria for a fiber-optic transmitter design with improved amplitude and phase-noise performance are developed through consideration of factors affecting the phase noise, including low-frequency laser-bias supply noise, the magnitude and proximity of external reflections into the laser, and temperature excursions of the laser-transmitter package. Author

N91-11977*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Tracking Systems and Applications Section.
NAVIGATIONAL UTILITY OF HIGH-PRECISION RADIO INTERFEROMETER FOR GALILEO'S APPROACH TO JUPITER
W. M. Folkner *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 34-46 (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 20N

The effect of very long baseline interferometry (VLBI) measurements of 2-nanoradian (nrad) accuracy has been studied for use in Galileo's approach to Jupiter's moon Io. Of particular interest is reducing the error in the minimum altitude above Io's surface. The nominal tracking strategy includes Doppler, range, and onboard optical data, in addition to VLBI data with 25-nrad accuracy. For nominal data, the altitude error is approximately 250 km with a data cutoff of 19 days before closest approach to Io. A limited number (two to four) of 2-nrad VLBI measurements, simulating a demonstration of improved VLBI data, were found to reduce the altitude error by 10 to 40 percent. Improving the accuracy of the VLBI measurements of the nominal tracking strategy to 2 nrads, to simulate the results from an operational few-nrad VLBI capability, was found to reduce the altitude error by an approximate factor of four. This reduction in altitude error is attributed to the ability that VLBI data give to help determine the along-track component of Jupiter's ephemeris. This capability complements the ability of the onboard optical data to determine the radial and cross-track components of Jupiter's ephemeris. Author

N91-11978*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.
LINEAR-PHASE APPROXIMATION IN THE TRIANGULAR FACET NEAR-FIELD PHYSICAL OPTICS COMPUTER PROGRAM **c61**
W. A. Imbriale and R. E. Hodges *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 47-56 (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 09B

Analyses of reflector antenna surfaces use a computer program based on a discrete approximation of the radiation integral. The calculation replaces the actual surface with a triangular facet representation; the physical optics current is assumed to be constant over each facet. Described here is a method of calculation using linear-phase approximation of the surface currents of parabolas, ellipses, and shaped subreflectors and compares results with a previous program that used a constant-phase approximation of the triangular facets. The results show that the linear-phase approximation is a significant improvement over the constant-phase approximation, and enables computation of 100 to 1,000 lambda reflectors within a reasonable time on a Cray computer. Author

N91-11979*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
SITE COMPARISON FOR OPTICAL VISIBILITY STATISTICS IN SOUTHERN ARIZONA **c47**
K. A. Cowles *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 57-61 (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 04B

One of the best locations in the continental United States for astronomical telescopes is southern Arizona. The mountains surrounding Tucson have clear skies 80 percent of the year, with image quality generally better than 2 seconds on peaks. Two of the existing observatory sites in this area are being considered as locations for one of the three Atmospheric Visibility Monitoring (AVM) observatories. These sites are Mount Lemmon and Mount Hopkins. A comparison of the characteristics of each of the sites is made here to identify the more desirable of the two locations. It is recommended that Mount Lemmon be selected as the Arizona site for this project. Author

N91-11980*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
THE THEORETICAL LIMITS OF SOURCE AND CHANNEL CODING
S. J. Dolinar and F. Pollara *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 62-72 (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 17B

The theoretical relationship among signal power, distortion, and bandwidth for several source and channel models is presented. The work is intended as a reference for the evaluation of the performance of specific data compression algorithms. Author

N91-11981*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
A HIGH-SPEED DISTORTIONLESS PREDICTIVE IMAGE-COMPRESSION SCHEME
K.-M. Cheung, P. Smyth, and H. Wang *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 73-90 (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 17B

A high-speed distortionless predictive image-compression scheme that is based on differential pulse code modulation output modeling combined with efficient source-code design is introduced. Experimental results show that this scheme achieves compression that is very close to the difference entropy of the source. Author

N91-11982*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Tracking Systems and Applications Section.
INTERAGENCY TELEMETRY ARRAYING FOR VOYAGER-NEPTUNE ENCOUNTER **c17**
D. W. Brown, W. D. Brundage (National Radio Astronomy Observatory, Socorro, NM.), J. S. Ulvestad, S. S. Kent, and K. P. Bartos *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 91-118 (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 09F

The reception capability of the Deep Space Network (DSN) has been improved over the years by increasing both the size and number of antennas at each complex to meet spacecraft-support requirements. However, even more aperture was required for the final planetary encounters of the Voyager 2 spacecraft. This need was met by arraying one radio astronomy observatory with the DSN complex in the United States and another with the complex in Australia. Following a review of augmentation for the Uranus encounter, both the preparation at the National Radio Astronomy (NRAO) Very Large Array (VLA) and the Neptune encounter results for the Parkes-Canberra and VLA-Goldstone arrays are presented. Author

N91-11983*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Radio Frequency and Microwave Subsystems Section.
THE PARKES FRONT-END CONTROLLER AND NOISE-ADDING RADIOMETER
T. J. Brunzie *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 119-138 (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 17B

A new front-end controller (FEC) was installed on the 64-m antenna in Parkes, Australia, to support the 1989 Voyager 2 Neptune encounter. The FEC was added to automate operation of the front-end microwave hardware as part of the Deep Space Network's Parkes-Canberra Telemetry Array. Much of the front-end hardware was refurbished and reimplemented from a front-end system installed in 1985 by the European Space Agency for the Uranus encounter; however, the FEC and its associated noise-adding radiometer (NAR) were new Jet Propulsion Laboratory (JPL) designs. Project requirements and other factors led to the development of capabilities not found in standard Deep Space Network (DSN) controllers and radiometers. The Parkes FEC/NAR performed satisfactorily throughout the Neptune encounter and was removed in October 1989. Author

N91-11984*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Telecommunications Systems Section.
THE IMPACT OF NRZ DATA ASYMMETRY ON THE PERFORMANCE OF A SPACE TELEMETRY SYSTEM **c17**
T. M. Nguyen *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 139-151 (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 09F

The telemetry data asymmetry due to rising and falling voltage transitions can cause undesired spectral components at the output of a spacecraft transmitter. The performance of a space telemetry system can potentially degrade because of these undesired components. Here, an expression is derived for the power spectral density of an asymmetric nonreturn-to-zero (NRZ) data stream. This formula is then used to investigate how the data bandwidth varies with data asymmetry. At the receiver end, the threshold levels of undesired spectral components that fall into the carrier-tracking-loop bandwidth are determined by examining the derived spectral density. Further, based on this formula, a simple technique is developed for the computation of bit signal-to-noise ratio (SNR) degradation due to data asymmetry. The telemetry bit SNR degradations derived using this technique are compared with results obtained previously and with measurements by the Electronic Systems Test Laboratory (ESTL) at the Lyndon B. Johnson Space Center. Author

N91-11985*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Space Physics and Astrophysics Section.
TECHNICAL CONSIDERATIONS ON USING THE LARGE NANCAY RADIO TELESCOPE FOR SETI **c89**
S. Gulkis, F. Biraud, J. Heidmann, and J. Tarter (California Univ., Berkeley.) *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 152-160 (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 03A

The Nancay decimetric Radio Telescope (NRT) in Nancay, France, is described, and its potential use for Search for Extraterrestrial Intelligence (SETI) observations is discussed. The conclusion reached is that the NRT is well suited for SETI observations because of its large collecting area, its large sky coverage, and its wideband frequency capability. However, a number of improvements are necessary in order to take full advantage of the system in carrying out an efficient SETI program. In particular, system sensitivity should be increased. This can be achieved through a series of improvements to the system, including lowering the ground pickup noise through the use of ground reflectors and more efficient feed design, and by using low-noise amplifier front ends. Author

N91-11986 Polytechnic Univ., Brooklyn, NY.
THE INFLUENCE OF THE UPLINK NOISE ON THE PERFORMANCE OF SATELLITE DATA TRANSMISSION SYSTEMS Ph.D. Thesis
Vrinda P. Dewal 1990 218 p
Avail: Univ. Microfilms Order No. DA9018398

The problem of transmission of binary phase shift keying (BPSK) modulated digital data through a bandlimited nonlinear satellite channel in the presence of uplink, downlink Gaussian noise and intersymbol interface is examined. The satellite transponder is represented by a zero memory bandpass nonlinearity, with AM/AM conversion. The proposed optimum linear receiver structure consists of tapped-delay lines followed by a decision device. The linear receiver is designed to minimize the mean square error that is a function of the intersymbol interface, the uplink and the downlink noise. The minimum mean square error equalizer (MMSE) is derived using the Wiener-Kolmogorov theory. In this receiver, the decision about the transmitted signal is made by taking into account the received sequence of present sample, and the interfering past and future samples, which represent the intersymbol interference (ISI). Illustrative examples of the receiver structures are considered for the nonlinear channels with a symmetrical and asymmetrical frequency responses of the transmitter filter. The transponder nonlinearity is simulated by a polynomial using only the first and the third orders terms. A computer simulation determines the tap gain coefficients of the MMSE equalizer that adapt to the various uplink and downlink noise levels. The performance of the MMSE equalizer is evaluated in terms of an estimate of the average probability of error.
Dissert. Abstr.

N91-11987# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
CONTRIBUTION TO THE STUDY OF CODED MODULATION SYSTEMS IN CONCATENATED CODES M.S. Thesis [CONTRIBUICAO AO ESTUDO DE SISTEMAS DE MODULACAO CODIFICADA EM CODIGOS CONCATENADOS]
Marco Antonio Chamon Nov. 1989 117 p In PORTUGUESE; ENGLISH summary
(INPE-5080-TDL/414) Avail: NTIS HC/MF A06

Coded modulation systems applied to concatenated codes are studied. The analyses of some trellis and block coded modulation schemes are shown and simulations are performed to choose the most suitable internal code for the concatenated scheme. The simulations show the trade-off among several import parameters of the trellis codes analyzed, such as code decision depth, number of quantization levels (for soft decision), and number of states in the trellis. The program developed for the simulations is included in the Appendix. The performance of the concatenated code is

presented and compared with the CCSDS standard code for concatenated schemes. Author

N91-11988*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AN EXPERIMENTAL STUDY OF HIGH Tc SUPERCONDUCTING MICROSTRIP TRANSMISSION LINES AT 35 GHz AND THE EFFECT OF FILM MORPHOLOGY
C. M. Chorey, K. B. Bhasin, J. D. Warner, J. Y. Josefowicz, D. B. Rensch, and C. W. Nieh (Hughes Research Labs., Malibu, CA.) Sep. 1990 7 p Presented at the Applied Superconductivity Conference, Aspen, CO, 24-28 Sep. 1990; sponsored in part by IEEE
(NASA-TM-103633; E-5758; NAS 1.15:103633) Avail: NTIS HC/MF A02 CSCL 20N

Microstrip transmission lines in the form of ring resonators were fabricated from a number of in-situ grown laser ablated films and post-annealed co-sputtered YBa2Cu3O(7-x) films. The properties of these resonators were measured at 35 GHz and the observed performance is examined in light of the critical temperature (Tc) and film thickness and also the film morphology which is different for the two deposition techniques. It is found that Tc is a major indicator of the film performance for each growth type with film thickness becoming important as it decreases towards 100 A. It is also found that the films with a mixed grain orientation (both a axis and c axis oriented grains) have poorer microwave properties as compared with the primarily c axis oriented material. This is probably due to the significant number of grain boundaries between the different crystallites, which may act as superconducting weak links and contribute to the surface resistance. Author

N91-11989# Electronics Research Lab., Adelaide (Australia).
GRAPH MATCH PROGRAM General Document
M rk T. Barrington Mar. 1990 58 p
(AD-A224819; ERL-0505-GD; DODA-AR-005-990) Avail: NTIS HC/MF A04 CSCL 17/9

A program is described for manipulating and comparing graphs of radar cross sections. The size and position of one graph relative to another can be changed and the two graphs combined to produce a new graph which represents an average of the two. The program can process data sets of varying numbers of data values. Graph Match was written using Apple Macintosh SE and II computers and Turbo Pascal as the programming language. GRA

N91-11990# BBN Systems and Technologies Corp., Cambridge, MA.
RADIO-PARAMETER SELECTION ALGORITHM FOR RECEIVER-DIRECTED PACKET-RADIO NETWORKS (SRNTN-73)
Julio Escobar 1990 76 p
(Contract MDA903-83-C-0173)
(AD-A224866; BBN-7172) Avail: NTIS HC/MF A05 CSCL 25/2

The Parameter Selection Algorithm for the SURAP 4 packet radio network and the basis for its design is described. A Semi-Markov model of the algorithm operation is presented. The algorithm adaptively adjusts three radio parameters: transmitter power, FEC coding rate, and channel bit rate. These parameters can increase the perceived signal-to-noise ratio on the channel and are treated as gain mechanisms. The algorithm must maintain robust radio links between nodes whenever possible, while minimizing interference with other network transmissions. We present one heuristic approach to balancing these two goals. This approach uses barely sufficient gain to maintain the packet error probability below an acceptable threshold value. A threshold probability of 0.1 was chosen. Bit error statistics provided by the sequential decoder and error feedback packets assist the process of determining the appropriate change of gain as noise levels vary. The algorithm can adapt at a fast rate, sometimes on the order of one packet time. It maintains acceptable packet error probability and can recover from estimation and decision errors. A Semi-Markov model can be used to compute the steady state packet error probability and packet transmission overhead due to noise. The model is general enough to include a stationary model of transceiver blocking probability, dynamic CDMA interference, and alternative algorithms based on similar operating principles. Although the model does not incorporate bit error statistic, a way is proposed to model the effect of these statistic without compromising the simplicity of the semi-Markov description. GRA

N91-11991# Naval Research Lab., Washington, DC. Communication Systems Branch.
EFFECT OF WORST-CASE MULTIPLE JAMMERS ON CODED FH/SSMA SYSTEMS Interim Report, Jan. 1988 - Jun. 1989
Evaggelos Geraniotis (Maryland Univ., College Park.) 31 Jul. 1990 41 p Sponsored by ONR, Arlington, VA
(AD-A224911; NRL-MR-6688) Avail: NTIS HC/MF A03 CSCL 17/4

The effect is characterized and evaluated of simultaneous multiple partial band noise or tone jammers and other-user interference on a single communication link employing frequency hopped spread spectrum (FH/SS) signaling, M-ary frequency shift keying (FSK) modulation with noncoherent demodulation, and Reed-Solomon coding. For the symbol error probability of these systems, exact expressions were derived in the absence of multiple access (MA) interference and tight upper bounds in the presence of other-user interference. Although the analytical methods are valid for any number of multiple jammers, the numerical study was restricted to the cases of two and three partial band noise and tone jammers. For fixed values of the spectral densities of noise jammers, or the energies per symbol of tone jammers, the worst case fraction was evaluated of the band that each jammer should use in order to maximize the error probability of the FH/SS or FH/SSMA system. For the range of the signal-to-jammer power ratios examined, multiple noise or tone jammers appear to have no advantage over a single noise or tone jammer of equivalent spectral density or energy per symbol but achieve approximately the same worst-case performance by jamming smaller fractions of the band. GRA

N91-11992# United International Engineering, Inc., Albuquerque, NM.
HARDENING SURVEILLANCE ILLUMINATION USING AIRCRAFT ANTENNAS Final Report, Mar. 1989 - Jan. 1990
J. P. Donohoe and C. D. Taylor Jun. 1990 139 p
(Contract F29601-88-C-0001; AF Proj. 3763)
(AD-A225143; WL-TR-90-27) Avail: NTIS HC/MF A07 CSCL 20/15

Aircraft maintenance depots and main operating bases need to be able to perform quick checks of the electromagnetic pulse (EMP) hardness of their systems without removing them from service for any length of time. Preliminary tests have shown that the onboard HF antennas of the EMP Test-Bed Aircraft (EMPTAC) may be capable of providing the HF excitation required to effectively monitor the EMP hardness of aircraft systems. The surface current and charge distributions on the EMPTAC which result from swept frequency excitation of the HF radio antennas are computed over a range of 0.5 to 100 MHz using various antenna drive configurations. The computational analysis is performed by using two separate frequency-dependent techniques: the method-of-moments technique and the physical optics approximation. These calculations are then compared with the excitation provided from an overhead plane wave and with measured data from EMPTAC tests. GRA

N91-11993# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Standards Approval Board For Telemetry, Tracking, Command and Data Handling.
RADIO FREQUENCY AND MODULATION STANDARD
Dec. 1989 68 p
(ESA-PSS-04-105-Issue-1; ISSN-0379-4059; ETN-90-97995)
Copyright Avail: NTIS HC/MF A04

Radio communication techniques to be used for the transfer

of information between spacecraft and ground stations in both directions, and for the tracking systems required for orbit determination, are defined. The following subjects are covered: frequency usage and frequency allocation; requirements on transmitted signals concerning spectral occupation, power levels, protection of other radio services etc; definition of the permissible modulation methods; specification of the major technical requirements which are relevant for the space/ground interface; operational aspects, for example acquisition. ESA

N91-11994# European Space Agency, Paris (France).
DOPPLER SPECTRA FROM INCOHERENT BACKSCATTER: PRINCIPLES AND EXAMPLES OF APPLICATION FOR POLDIRAD
Werner Meyer and Thomas Jank (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) Aug. 1990 60 p Transl. into ENGLISH of Dopplerspektren aus Inkohaerenter Rueckstreuung: Prinzip und Anwendungsbeispiele fuer POLDIRAD (Oberpfaffenhofen, Fed. Republic of Germany, DFLR), Aug. 1989 49 p Original language document was announced as N90-18630
(ESA-TT-1197; DLR-FB-89-48; ETN-90-98011) Avail: NTIS HC/MF A04

It is possible with the aid of Doppler radars to measure the distribution of radio velocities of scattering particles in the measuring volume. The parameters represented by the mean velocity and width of the distribution of radial velocities can be determined from the first two moments of these Doppler spectra. The principles for interpretation of Doppler spectra obtained from incoherent backscatter are summarized. How accurately the mean velocity and spectra width can be determined with POLDIRAD is investigated using simulations of spectra. An example of application is given. ESA

N91-11995# European Space Agency, Paris (France).
ON THE RANGE RESOLUTION OF POINT TARGETS WITH FMCW RADAR SYSTEMS
Reinhard Hammel (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) Aug. 1990 93 p Transl. into ENGLISH of Zur Entfernungsaufloesung von Punktzielen mit FMCW-Radarsystemen (Oberpfaffenhofen, Fed. Republic of Germany, DFLR), Aug. 1989 75 p Original language document was announced as N90-18629
(ESA-TT-1206; DLR-FB-89-47; ETN-90-98013) Avail: NTIS HC/MF A05; original German version available from DLR, Wissenschaftliches Berichtwesen, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 24 Deustche marks

The spectral analysis of the low pass filtered echo signals of a stationary point target was carried out starting with the precise position of the transmit signal of a Frequency Modulated Continuous-Wave (FMCW) radar operated with sawtooth modulation and assuming a signal transit time which is short compared with the modulation period. It can be stated that the minimum detectable spacing between two point targets in the line of bearing is approximately given by 2.2 times the quantization width. To improve the target detection and for increasing the contrast in microwave images, the low frequency difference signal is frequently smoothed in the time domain by means of a trigonometric weighting function: An approach of linearizing the frequency/time characteristic is described. ESA

N91-11996# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
DEVICE FOR IRRADIATING LARGE PARABOLIC-REFLECTOR ANTENNAE
E. A. Dudkovskiy 27 Jun. 1990 6 p Transl. into ENGLISH of Russian Patent no. 146365, 17 Jul. 1962 p 1-2
(AD-A225262; FTD-ID(RS)T-0683-90) Avail: NTIS HC/MF A02 CSCL 20/6

Devices are described that irradiate large parabolic reflector antennae. The described device is different from the known devices because the parabolic reflector used in it is cofocal with the basic mirror, which is irradiated by a cophasal emitter grid with a uniform amplitude distribution. This makes it possible to obtain the maximum utilization factor of the mirror opening cross section. The figure shows a schematic diagram of the device for irradiating large parabolic aerials. GRA

N91-11997# Naval Ocean Systems Center, San Diego, CA.
SUPER HIGH FREQUENCY (SHF) LINK ANALYSIS MODEL (SLAM) FOR NONSATELLITE APPLICATIONS Final Report
R. R. James and J. W. Rockway Jun. 1990 66 p
(AD-A225323; NOSC-TR-1350) Avail: NTIS HC/MF A04 CSCL 20/14

A point-to-point link analysis model has been developed for the Super High Frequency (SHF) band. It was developed to evaluate ship-to-ship and ship-to-air links. The SHF Link Analysis Model (SLAM) evaluates a communication link and determines system margin. The link margin is determined after a user defines the transmitter subsystem, the receiver subsystem, the specified level of system performance, and the propagation channel. The propagation channel incorporates the Engineer's Refractive Effects Prediction System (EREPS) and includes the effects of the evaporation duct. A rain model developed by NASA is also included in the channel. SLAM provides a detailed discussion of the link equation, the propagation effects, the rain model, and the antenna characteristics. In addition, a detailed explanation of the operation of the SLAM computer program is given. Two communication links are evaluated and these examples are used to demonstrate the computer program's capabilities. GRA

N91-11998# Harry Diamond Labs., Adelphi, MD.
SIGNAL-PROCESSING TECHNIQUES FOR SIMULATED WIDEBAND MONOPULSE RADAR DATA Summary Report, Jan. 1988 - Jan. 1989
Ronald J. Wellman and Jerry L. Silvious Apr. 1990 43 p
Sponsored by Army Materiel Command, Alexandria, VA
(AD-A225334; HDL-TR-2178) Avail: NTIS HC/MF A03 CSCL 17/9

A computer simulation is presented of the signals received by a coherent, frequency-agile, two coordinated monopulse radar from an array of point reflectors. A FORTRAN program for analyzing these simulated signals is used to obtain down-range and cross-range locations of the reflectors. Inverse Synthetic Aperture Radar (ISAR) techniques also are used to obtain a radar-cross-section-density image of a two-dimensional array to reflectors. The effects of system phase and amplitude noise also are examined. GRA

N91-11999# Naval Postgraduate School, Monterey, CA. Dept. of Administrative Sciences.
NATIONWIDE MOBILE COMMUNICATION SYSTEMS, VOLUME 1, CHAPTERS 1 THRU 4 M.S. Thesis
William Joseph Schworer, III Jun. 1990 247 p
(AD-A225366) Avail: NTIS HC/MF A11 CSCL 25/5

This thesis provides a basic understanding of nationwide terrestrial and satellite mobile communications and tracking technologies. Covered are systems currently available and in development. An analysis of user costs is performed for comparison. A more detailed satellite cost/benefit analysis for use by the trucking industry is also presented. Follow-on chapters contain discussions of the basic economic issues faces by satellite system operators and the regulatory history of mobile satellite services. Contained in the appendices are a more detailed discussion of mobile satellite systems and a layman's explanation of communication and navigation technologies. The conclusion presents comments on the possible future direction of these new mobile communication services and makes recommendations for trucking industry use. GRA

N91-12000# Naval Postgraduate School, Monterey, CA. Dept. of Administrative Sciences.
NATIONWIDE MOBILE COMMUNICATION SYSTEMS. VOLUME 2, CHAPTER 5: APPENDIX A M.S. Thesis
William Joseph Schworer, III Jun. 1990 252 p
(AD-A225367) Avail: NTIS HC/MF A12 CSCL 25/2

Previous chapters discussed nationwide mobile communication system technologies and modeled user costs and benefits. This chapter provides a brief overview of mobile communication system economics, the projected U.S. market for nationwide mobile communications, and the potential revenues. The basic cost structure of satellite and meteor-burst systems are also modeled. A combination of all these factors will ultimately govern which systems will be commercially successful. Because of improvements in technology, communication system costs and user terminal costs (A) per unit of capacity tend to decline over time. However, inflation tends to drive the price of an identical product upward over time. GRA

N91-12001# Naval Postgraduate School, Monterey, CA. Dept. of Administrative Sciences
NATIONWIDE MOBILE COMMUNICATION SYSTEMS. VOLUME 3: APPENDIX B - D M.S. Thesis
William Joseph Schworer, III Jun. 1990 191 p
(AD-A225368) Avail: NTIS HC/MF A09 CSCL 25/5

The following contents include: Communication, Satellite and Navigation Concepts, Mobile Communications Cost/Benefit Spreadsheet, and Operating Statistics and Cost Analysis. GRA

N91-12002# Naval Postgraduate School, Monterey, CA. Dept. of Electrical and Computer Engineering.
AN ELECTROMAGNETIC RADOME MODEL USING AN INTERACTIVE MICRO-COMPUTER FINITE ELEMENT ALGORITHM M.S. Thesis
Robert Johnston Vince Dec. 1989 175 p
(AD-A225370) Avail: NTIS HC/MF A08 CSCL 17/9

The goal of this thesis was to develop and validate a set of microcomputer programs using, in part, a previously written finite-element algorithm to analyze the perturbation of an incident electromagnetic field as it penetrates a missile radome. An interactive program was developed to design the radome structure using aerodynamic shaping functions and provide structure and material files as input to the finite-element code. A second program was developed to use the spherical harmonic expansion coefficients provided by the finite-element code to assemble the electromagnetic fields within the radome core and to display the fields that appear across a planar antenna with three-dimensional graphics for any orientation of the antenna. Algorithms were included which compare the computed field components to the theoretical incident plane wave for each stipulated angles of incidence, in order to determine the perturbation due to the presence of the radome. Validation of the computational method was attempted by analyzing the perturbation indicated for an ideal radome with relative permittivity of unity. The attempted validation showed phase errors in the computed fields which were minimal for axial incidence, but became significant for highly canted incidence. GRA

N91-12003# Harry Diamond Labs., Adelphi, MD.
THE NORMAL MODE E- AND H-FIELD DISTRIBUTION IN THE CONCENTRIC SPHERICAL CAVITY Final Report, Dec. 1987 - Dec. 1988
Louis F. Libelo and Guy E. Pisane Apr. 1990 117 p
(AD-A225388; HDL-TR-2168) Avail: NTIS HC/MF A06 CSCL 20/3

The eigenfields of the concentric spherical cavity are investigated in this report. This simple cavity structure serves as a foundation toward understanding a number of important practical problems. The fields are developed mathematically, and extensive computer-generated graphs are presented. A thorough exposition accompanies the graphs explaining how the fields vary with the cavity parameters in a systematic fashion, and how they relate to the corresponding eigenvalue mode charts. GRA

N91-12004# Ohio State Univ., Columbus. ElectroScience Lab.
TM SCATTERING BY A VARIABLE SHEET IMPEDANCE IN A MULTILAYERED SLAB
Matthew E. Peters and Edward H. Newman Mar. 1990 73 p
(Contract N00014-89-J-1007)
(AD-A225586; TR-721566-1) Avail: NTIS HC/MF A04 CSCL 20/3

The problem considered is two-dimensional transverse magnetic (TM) scattering by a variable sheet impedance in a multilayered slab. An integral equation is formulated for the sheet impedance in the multilayered slab. This integral equation is solved for the surface currents flowing on the sheet impedance using a spectral domain moment method (MM)/Green's function solution. The MM solution is outlined and expressions for the expressions for the matrix elements are obtained. A user oriented computer code was written to implement the solution. Numerical results are obtained and are compared with measured or previously calculated results. GRA

N91-12005# Beleidscommissie Remote Sensing, Delft (Netherlands).
ANALYSIS OF IRIS AND VARAN-S IMAGE DATA, AUTOMATED GEOMETRICAL PROCESSING, AND DATA EXTRACTION [ANALYSE VARAN-S EN IRIS RADARBEELDEN GEAUTOMATISEERDE GEOMETRISCHE VERWERKING EN DATA EXTRACTIE]
B. M. Braam, H. J. Buiten, D. H. Hoekman, and H. J. C. vanLeeuwen (Wageningen Agricultural Univ., Netherlands) Feb. 1990 134 p In DUTCH
(BCRS-89-37; ETN-90-97686) Avail: NTIS HC/MF A07

The data collected during several flights with the VARAN-S and IRIS SAR (Synthetic Aperture Radar) imaging radar systems over the Fleroland test site were analyzed in the framework of the AGRISCATT-87 campaign. The image processing and data extraction were automated because of the large amount of work and routine actions for every single image. A method was developed which makes it possible to process the (multidimensional) radar data. It is possible to join all the images to a geometrical reference so that production of tables, for example field averages, are easy and can be easily adjusted according to the wishes of the researchers. Topographical overlays can be made. The end product is a basic technique delivering tables and geometrically corrected images which are needed for the analysis of the VARAN-S and IRIS data. ESA

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N91-12006# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
ACCESS DEFINITION OF MULTIPOLES CHARACTERIZED FROM INDEFINITE ADMITTANCE MATRIX [DEFINICAO DE ACESSOS EM MULTIPOLOS CARACTERIZADOS PELA MATRIZ DE ADMITANCIA INDEFINIDA]
Claudemir MarcosdaSilva and Edson GusellaJunior May 1988 12 p In PORTUGUESE; ENGLISH summary Presented at the 3rd Symposium on Microwaves Submitted for publication
(INPE-4536-PRE/1283) Avail: NTIS HC/MF A03

A method of reduction is presented for the indefinite admittance matrix of a multipole that permits the definition of access without common terminal reference and with the most general termination for dipoles. Transl. by B.G.

N91-12007# Oak Ridge National Lab., TN.
INSULATING MATERIALS AND LARGE HIGH VOLTAGE ELECTRIC SYSTEMS Foreign Trip Report
Steinar J. Dale 18 Sep. 1990 15 p
(Contract DE-AC05-84OR-21400)
(DE90-017851; ORNL/FTR-3744) Avail: NTIS HC/MF A03

The traveler attended the 33rd Session of CIGRE (The

International Conference on Large High Voltage Electric Systems) as a U.S. technical expert advisor. Over 200 papers were discussed, contributed from over 45 countries at the conference on all aspects of electric power generation and transmission. Of special interest was a panel session on superconducting technology for electric power systems and the participation on a new task force on the electrical insulation at cryogenic temperatures. Significant insight was gained into the development of superconducting power technologies in Europe and Japan. CIGRE has set up a committee to follow the development in research on the biological effects of electric and magnetic fields. The traveler also visited the Centre for Electric Power Engineering at the University of Strathclyde, Glasgow, Scotland and discussed research on degradation of polymeric cable insulation and gas insulated equipment. DOE

N91-12008# Illinois Univ., Urbana-Champaign. Dept. of Electrical Engineering.
CURRENT DENSITY CALCULATION USING RECTILINEAR REGION SPLITTING ALGORITHM FOR VERY LARGE SCALE INTEGRATION METAL MIGRATION ANALYSIS M.S. Thesis
Hungse Cha Jul. 1990 63 p
(Contract F30602-88-D-0028)
(AD-A224750; UILU-ENG-90-2223; DAC-22) Avail: NTIS HC/MF A04 CSCL 20/3

In Very Large Scale Integration (VLSI) chips, metal migration (MM) is an important problem from the reliability standpoint. Furthermore, as the feature size is scaled down, MM becomes an even greater problem because of the higher current densities that would exist in the power and ground busses. Because of the complexity of VLSI power busses, there exists a need for a computer-aided design tool to correctly predict the likely failure site(s). A primitive splitting algorithm that calculates current density waveforms efficiently is examined. These waveforms are used to find the Median Time to Failure (MTF), a major parameter of concern in predicting MM. This algorithm was motivated by examining the equipotential plots obtained through finite element method analysis of simple regions. It was successfully implemented and tested, and some examples are described. GRA

N91-12009# California Univ., Los Angeles. Dept. of Chemistry.
ELECTRICAL RESISTIVITY, MAGNETIC SUSCEPTIBILITY, AND THERMOELECTRIC POWER OF PtGa2 Technical Report No. 1, 1 Oct. 1989 - 31 May 1990
Li-Shing Hsu, Lu-Wei Zhou, F. L. A. Machado, W. Gilbert Clark, and R. Stanley Williams 1 Jul. 1990 18 p Submitted for publication
(Contract N00014-90-J-1178; NSF DMR-84-09390)
(AD-A225035) Avail: NTIS HC/MF A03 CSCL 09/1

The electrical resistivity (p), magnetic susceptibility (X) and thermoelectric power (S) of PtGa2 were measured as a function of temperature (T). This compound is metallic at high temperatures, as shown from the room-temperature resistivity value and the linear dependence of the S vs. T curve at temperatures above the Debye temperature. It undergoes a superconducting phase transition with a critical temperature (Tc) at zero magnetic field of 2.13K. The density of states (DOS) at the Fermi energy (EF) at high temperatures obtained from X and S data are 22 and 15 percent higher, respectively, than the value obtained previously from a semi-empirical band-structure calculation. GRA

N91-12010# California Univ., Los Angeles. Dept. of Chemistry.
ANALYSIS OF SCANNING TUNNELING MICROSCOPE TOPOGRAPHS OF GRAPHITE SURFACES ROUGHENED BY Ar(+) ION BOMBARDMENT Technical Report No. 2, 1 Oct. 1989 - 31 May 1990
Elliott A. Eklund, R. Stanley Williams, and Eric J. Snyder 1 Jul. 1990 8 p Submitted for publication
(Contract N00014-90-J-1178)
(AD-A225037) Avail: NTIS HC/MF A02 CSCL 09/1

The scanning tunneling microscope (STM) has been used to investigate graphite surfaces roughened by 5 ke V Ar+ion bombardment. The (0001) surfaces of several samples were etched with the same total ion dose but with different sputter rates for each surface. STM images taken after sputtering show that the roughness of the sputtered surfaces depended on the sputter rate and that the surface topography of each sample appeared self-similar over a large range of length scales. These experimental observations agree with predictions of the recently proposed Shadow Model. The two dimensional height-height correlation function is utilized as a means of quantitative analysis for STM topographs of sputtered surfaces. GRA

N91-12011# Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemistry.
SYNTHESIS, TRANSPORT, AND MICROSTRUCTURAL PROPERTIES OF Nd(1.85)Ce(0.15)CuO(4-DELTA) Technical Report No. 48, 1 Jun. 1989 - 30 May 1990
Jong-Gyu Lee, K. V. Ramanujachary, and M. Greenblatt 1 Jun. 1990 6 p Submitted for publication
(Contract N00014-82-K-0317; NSF DMR-87-14072)
(AD-A225049) Avail: NTIS HC/MF A02 CSCL 09/1

The n-type superconductor, Nd1.85Ce0.15CuO(4-delta) was prepared by solid state reaction and solution precursor techniques under various conditions and characterized by means of X ray diffraction, magnetic susceptibility, electrical resistivity and SEM measurements. Samples prepared by solution method displayed higher normal state resistance but better superconducting volume fractions than those prepared by conventional ceramic techniques. In addition, the solution precursor technique reduces the sintering temperature from 1150 C (used for solid state route) to 1000 C in achieving the superconducting phase. The solution-route yields particles with relatively uniform size distribution, but poor connectivity between the grains. In contrast, the solid state preparations yield well connected grains but with a larger distribution of sizes. The observed differences in the superconducting properties of samples prepared by different techniques were attributed to the differences in their microstructure. GRA

N91-12012# Naval Surface Weapons Center, Silver Spring, MD. Dept. of Research and Technology.
SBIR REPORTS ON THE CHEMISTRY OF LITHIUM BATTERY TECHNOLOGY
W. P. Kilroy, ed. Nov. 1989 183 p
(Contracts N60921-86-C-A457; N60921-88-C-0058; N60921-86-C-0274; N60921-88-C-0057)
(AD-A225139; NSWC-MP-89-242) Avail: NTIS HC/MF A09 CSCL 10/3

The following contents are included: Identification of an Improved Mixed Solvent Electrolyte for a Lithium Secondary Battery; Catalyzed Cathodes for Lithium-Thionyl Chloride Batteries; Improved Lithium/Thionyl Chloride Cells Using New Electrolyte Salts; Development of Calcium Primary Cells With Improved Anode Stability and Energy Density. GRA

N91-12013# Sandia National Labs., Albuquerque, NM. Battery Development Div.
CHARACTERISTICS AND DEVELOPMENT REPORT FOR THE MC3714 THERMAL BATTERY
Gregory L. Scharrer and Frank P. Lasky Aug. 1990 28 p
(Contract DE-AC04-76DP-00789)
(DE91-000095; SAND-89-0688) Avail: NTIS HC/MF A03

The design intent, design considerations, system use, development, product characteristics, and early production history of the MC3714 Thermal Battery was described. This battery has a required operating life of 146 s above 24.0 V with a constant current load of 0.5 A. It is activated when the MC3830 Actuator initiates the WW42C1 Percussion Primer in the battery. The MC3714 employs the Li(Si)/LiCl-CCl/lithiated FeS2 electrochemical system. The battery is a hermetically sealed right circular cylinder with an antirotation ring brazed to the base of the cylinder. The battery is 50 mm long and 38.1 mm in diameter. The mass of the battery is 165 g. The battery was designed and developed to provide the power for the W82 JTA Telemetry System. DOE

N91-12014# Universiteit Twente, Enschede (Netherlands).
CMOS MULTIPLE-VALUED LOGIC CIRCUITS Ph.D. Thesis
Siep Onneweer 1989 212 p Sponsored by Stichting voor Fundementeel Onderzoek der Materie
(ISBN-90-9002692-4; ETN-90-97769; UDC-621.38(043.3))
Copyright Avail: NTIS HC/MF A10

The development of electronic circuit realizations of multiple valued logic is addressed. CMOS circuits were investigated and a current mode CMOS logic, based on a very small set of basic circuit elements, results. The basic elements of current mode CMOS logic, their computer aided design and experimental evaluation and verification are described. Contributions of the study to circuit design, logic design and computer aided logic synthesis are summarized. ESA

N91-12015# European Space Agency, Paris (France).
DEVELOPMENT AND TEST OF POWER AMPLIFIERS FOR DRIVING LOW-VOLTAGE PIEZO-ACTUATORS IN MULTISTABLE INTERFEROMETERS
Hans Naumann and Walter Schmidt (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) Aug. 1990 44 p Transl. into ENGLISH of Entwicklung und Test von Leistungsverstaerkern fuer Niedervolt-Piezoantriebe zum Einsatz in Multistabilen Interferometern (Brunswick, Fed. Republic of Germany, DFLR), 1989 Original language document was announced as N90-18662
(ESA-TT-1196; DLR-Mitt-89-19; ETN-90-98010) Avail: NTIS HC/MF A03

A power amplifier for capacitive loads such as low voltage piezoelectric translators is described. Various features such as offset control, input attenuation, filtering and hysteresis compensation, required for use in arrangements with multistable interferometers, are discussed. The results relating to optical multistabilty were satisfactory. Up to 95 stable steps were achieved in the optical analog/digital conversion. ESA

N91-12016# Air Force Systems Command, Wright-Patterson AFB, OH.
INTERLOCK DEVICE
Yu. A. Ananyev, V. F. Borisov, V. M. Irtuganov, V. P. Kalinin, and V. S. Popov 12 Jun. 1990 8 p Transl. into ENGLISH of Russian Patent no. 421084, 25 Apr. 1972 p 1-2
(AD-A225261; FTD-ID(RS)R-0410-90) Avail: NTIS HC/MF A02 CSCL 10/2

The invention pertains to pulsed power supplies and can be used in protecting flash tubes from surges in laser pumping systems. There exists an interlock device containing (parallel-connected to each other) an inductive storage, a load in the form of m branches, each of which consists of n series-connected gas filled flash tubes, an interlock discharger with a firing unit and a current supply connected across a current commutator to the inductive storage, a control pulse generator, and a flash tube firing element. In this device, the interlock discharger is started by means of a circuit for comparing the voltage in the load with the reference voltage, which does not enable the tubes to be reliably protected against overloading when some of them fail because the surge effects at the output of the inductive storage are smoothed out due to mutual shunting of the parallel load branches and the resistance drop in flash tubes with rise in current. GRA

N91-12017# Naval Postgraduate School, Monterey, CA.
VARIABLE-FREQUENCY PULSE-WIDTH-MODULATION (PWM) FOR ZERO VOLTAGE SWITCHING IN A BOOST dc-dc REGULATOR M.S. Thesis
Daniel S. Hunter Mar. 1990 68 p
(AD-A225303) Avail: NTIS HC/MF A04 CSCL 10/2

A technique for operating a pulse width modulated (PWM) dc-dc regulator in the boost mode while switching the MOSFET when the drain-to-source potential is near zero volts was developed and is described. This is accomplished by using frequency-modulation in addition to pulse width modulation. Zero-voltage switching will provide power converter designers an alternative for designing high frequency converters with minimal transient turn-on losses, the predominant form of converter losses experienced in high frequency operation. High frequency operation will result in smaller reactive components, which produce higher power density converters, as well as increasing the transient response of the regulated converter. In addition to allowing for high frequency operation, the design exhibits many desirable power switch properties, such as limiting the peak voltage to the output voltage level and operating with the minimum possible current levels for a given power requirement. A circuit built and tested utilizing zero-voltage switching in a regulated boost converter verified the principles of operation for yielding a high efficiency, high frequency converters. GRA

N91-12018# Naval Postgraduate School, Monterey, CA.
CIRCUIT MODELS FOR INDUCTIVE STRIPS IN FIN-LINE M.S. Thesis
Georgios Karaminas Dec. 1989 108 p
(AD-A225309) Avail: NTIS HC/MF A06 CSCL 09/1

This thesis describes a computer aided design (CAD) compatible circuit model for an inductive strip centered in WR(90) fin-line with W/b less than 1, E, =1. The circuit model is shown to predict strip scattering coefficients which agree closely with those computed numerically using the spectral domain method. GRA

N91-12019# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Electrical and Computer Engineering.
OPTIMAL PHASE-ONLY FILTERS Final Report, Apr. 1988 - Aug. 1989
B. V. Kumar and Z. Bahri Apr. 1990 100 p
(Contract F19628-88-K-0018)
(AD-A225312; RADC-TR-90-17) Avail: NTIS HC/MF A05 CSCL 12/9

Phase-only Filters (POFs) and Binary Phase-only Filters (BPOFs) were studied. It is proved that the conventional POF introduced originally by Horner and Gianino is indeed the best among all POFs from the viewpoint of maximizing the Signal-to-Noise Ratio (SNR). The importance is illustrated of selecting the optimal support function for the POF and show with the help of example images that output SNR can be improved considerably (by about 5 dB) by using optimal POFs (OPOFs). An efficient algorithm is described for designing OPOFs. Because of their suitability for binary Spatial Light Modulators (SLMs) such as the Magneto Optic SLM (MOSLM), binary POFs (BPOFs) are of much interest. The optimal BPOF (OBPOF) is introduced and efficient algorithms are presented for designing OBPOFs. Several simulation results based on the use of 32 X 32 images are included to verify the performance of OBPOFs. GRA

N91-12020# Naval Postgraduate School, Monterey, CA.
PHYSICAL PROCESSES IN HOLLOW CATHODE DISCHARGE M.S. Thesis
Hwang-Jin Han Dec. 1989 61 p
(AD-A225329) Avail: NTIS HC/MF A04 CSCL 09/1

The hollow cathode is an effective source of dense, low energy plasma. Hollow cathodes find use in ion beam sources for laboratory and space applications. They can also be used independently for satellite charge control, and ion beam neutralization. A heaterless hollow cathode design was tested with argon gas used as a propellant. The device properties, that is, the emission currents as a function of discharge current, propellant flow rate and other physical parameters were investigated. Starting behavior was a main point of the investigation. The results of these experiments were compared with studies of the conventional hollow cathode. GRA

N91-12021# Air Force Systems Command, Wright-Patterson AFB, OH.
THEORY AND SIMULENT DESIGN OF A TYPE OF AUTO-SELF-PROTECTING OPTICAL SWITCHES
Binhong Li and Songcun Peng 11 Jun. 1990 21 p Transl. into ENGLISH from Shanghai Jiaotong Daxue Xuebao (Peoples

Republic of China), no. 6, 1984 p 11-23
(AD-A225344; FTD-ID(RS)R-0306-90) Avail: NTIS HC/MF A03 CSCL 20/6

As the use of lasers in the military and in the civilian economy increases with each passing day, it is often necessary for the human eye or sensitive instruments to observe weak lasers, such as the return waves of laser radar and laser communications signals; but it is also necessary to provide protection against damage to the eye from the strong lasers of enemy laser weapons. For this reason, it is necessary to have a kind of automatic optical self-protecting switch. Based upon a study of the transmitting and scattering characteristics of multilayer dielectric optical waveguides, a practical computer program is set up for designing a type of auto-self-protecting optical switch with a computer model by using the nonlinear property of dielectric layers and the plasma behavior of metal substrates. This technique can be used to protect the human eye and sensitive detectors from damage caused by strong laser beams. GRA

N91-12022# Maine Univ., Orono. Dept. of Electrical Engineering.
INTERFACE-STATE MEASUREMENTS OF GaAs SCHOTTKY BARRIERS USING ADMITTANCE TECHNIQUES: RELATIONSHIP TO BARRIER HEIGHT INSTABILITY Final Technical Report, Jun. 1977 - Aug. 1989
Keith A. Christianson Feb. 1990 52 p
(Contracts F30602-88-D-0025; F30602-88-D-0026)
(AD-A225459; RADC-TR-89-346) Avail NTIS HC/MF A04 CSCL 09/1

A recent series of measurements has shown that the barrier height of Schottky diodes on GaAs may change under long term biasing conditions. The aging has been found to occur under reverse bias conditions with a logarithmic dependence on time. This study has been concerned with looking at the interface-state configuration of these diodes using admittance techniques to see if interface-state generation/destruction plays any role in this aging process. Two groups of diodes, Au/W/GaAs and Au/Pt/Ti/GaAs, were studied. Both of these diode types are contained within power MESFET structures. As has been reported elsewhere, the Au/W/GaAs, diodes exhibit pronounced aging effects, while the Au/Pt/Ti/GaAs diodes show this effect only slightly. Two variations of the admittance technique were tried. The first variation, which looked for conductance variations as a function of frequency, was not successful, presumably due to the relatively large values of conductance already present in these structures making small variations impossible to see. The second variation looked at forward bias capacitance using a specially modified bridge circuit which enabled the large conductance signal to be nulled out. In order to obtain the interface-state densities from the forward bias capacitance data several assumptions had to be made so that existing theory could be applied. The first of these was that the responsible species are donor interface-states which reside in the upper half of the bandgap. GRA

N91-12023# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Hubschrauber und Flugzeuge.
THE ELECTRIC POWER FEEDING ON SIGNAL/ELECTRIC POWER SUPPLY CIRCUITS, AS A PROCESS FOR THE SIMULATION OF EXTERNAL RADIO-FREQUENCY INTERFERENCES [DIE STROMEINSPEISUNG AUF SIGNAL-/STROMVERSORGUNGSKREISE ALS VERFAHREN ZUR SIMULATION EXTERNER HOCHFREQUENZSTOERUNGEN]
Alfred Brenner Aug. 1989 4 p In GERMAN Presented at Internationalen Fachmesse und Kongress fuer Elektronische Vertraeglichkeit, Karlsruhe, Fed. Republic of Germany, 19 Oct. 1988
(MBB/FE324/S/PUB/378; ETN-90-97847) Copyright Avail: NTIS HC/MF A01

When designing and checking modern aircrafts, the electromagnetic interference environment in power station range has to be considered. On account of the geometrical dimensions of planes, the airframe and the cabling in resonance take up a great deal of the interference activity. The drawbacks of the classical methods being outlined, a new process for the simulation of external high frequency disturbances was developed: the Bulk Current Injection Test (BCIT). Its principles are reported, it is shown that for the determination of an improvement factor the method is very useful, as well as for relative measurements. But the BCIT method takes a lot of time, even using computers. ESA

N91-12024# Technische Univ., Delft (Netherlands).
FUNDAMENTAL ASPECTS AND DESIGN OF FM UPCONVERSION RECEIVER FRONT-END WITH ON-CHIP SAW FILTERS Ph.D. Thesis
Paulus Thomas Maria vanZeijl 1990 151 p
(Contract STW-DEL-44-0592)
(ETN-90-98136) Avail: NTIS HC/MF A08

The characteristics of FM (Frequency Modulation) receivers, including tuned radio frequency and single conversion receivers, are described. The modeling of SAW (Surface Acoustic Wave) delay lines, SAW transversal filters and the behavior of SAW resonators and SAW resonator filters are discussed. The design of the FM upconversion receiver front end is described and a new class of balanced dual loop amplifiers is discussed. ESA

N91-12025# Helsinki Univ. of Technology, Espoo (Finland). Radio Lab.
MILLIMETER-WAVE SCHOTTKY MIXER RECEIVERS FOR APPLICATIONS IN ANTENNA MEASUREMENTS AND RADIO ASTRONOMY Ph.D. Thesis
Arto Olavi Lehto Jun. 1990 21 p Sponsored by Jenny ja Antti Wihurin Rahasto and Tekniikan Edistaermissaatio
(Rept-S-185; ISBN-951-22-0271-9; ISSN-0355-5712; ETN-90-98230) Avail: NTIS HC/MF A03

Whisker contacted Schottky mixer receivers and some of their applications are addressed. As an introduction to more detailed study, for which references are given, the noise sources and construction of Schottky mixers and receivers are explained. A summary of the other studies is given: an embedding network for a single ended whisker contacted millimeter wave mixer; measurement of the amplitude and phase patterns of two corrugated feed horns; a method of measuring absorption losses and beam efficiencies of large reflector antennas at millimeter wave frequencies; the construction of of 40 to 50 GHz cooled Schottky mixer front end; a 75 to 95 GHz cooled Schottky mixer receiver. ESA

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N91-12026 Clarkson Univ., Potsdam, NY.
A NUMERICAL STUDY OF TURBULENT PIPE FLOW Ph.D. Thesis
David Masser Irwin 1990 106 p
Avail: Univ. Microfilms Order No. DA9025574

Turbulence in pressure driven pipe flow is numerically simulated from the three-dimensional incompressible Navier-Stokes equations written in rotation form. The velocity and pressure-head fields are represented by truncated Fourier series azimuthally and axially and by Chebyshev series in the radial direction. A fractional time stepping method separates the equations into three parts which evaluate the cross-product, pressure, and viscous terms separately by determining intermediate fields and calculating the correction due to each. Pseudo-spectral operations and fast Fourier transforms are incorporated to evaluate the cross-product. Eigenvector/eigenvalue solutions of the Poisson-like equations involved in the pressure and viscous parts are computed in a pre-processing code and coupled with streamlined matrix

multiplications used in production runs. These methods and techniques provide for accuracy and efficiency. Various 2-D and 3-D linear tests of the simulation have conformed to calculated analytical results. Demonstrations of transitions to turbulence by examining 3-D growth in the presence of a 2-D finite amplitude perturbation were in agreement with previous published numerical computations of a similar nature. The calculations have determined that various statistical properties of the generated velocity fields compare favorably with available experimental data for fully developed turbulent flow. Dissert. Abstr.

N91-12027 Virginia Polytechnic Inst. and State Univ., Blacksburg.
VISUALIZATION AND VELOCITY MEASUREMENT OF UNSTEADY FLOW IN A GAS GENERATOR USING COLD-FLOW TECHNIQUE Ph.D. Thesis
Subrahmanyam Kuppa 1990 157 p
Avail: Univ. Microfilms Order No. DA9023160

Modeling of internal flow fields with hot, compressible fluids and sometimes combustion using cold flow techniques is discussed. The flow in a gas generator was modeled using cold air. The experimental set up was designed and fabricated to simulate the unsteady flow with different configurations of inlet tubes. Tests were run for flow visualization and measurement of axial velocity at different frequencies ranging from 5 to 12 Hz. Flow visualization showed that the incoming flow was a complex jet flow confined to a cylindrical enclosure, while the outgoing flow resembled the venting of a pressurized vessel. The pictures show a complex flow pattern due to the angling of the jet towards the wall for the bent tube configurations and straightened flows with straight tube and other configurations with straighteners. Velocity measurements were made at an inlet Re of 8.1 x 10(exp 4) based on maximum velocity and inlet diameter. Phase averaged mean velocities were observed to be well defined during charging and diminished during venting inside the cylinder. For the straight tube inlet comparison with a steady flow measurement of sudden expansion flow showed a qualitative similarity of the mean axial velocity distribution and centerline velocity decay during the charging phases. For the bent tube inlet case the contour plots showed the flow tendency towards the wall. Two cells were seen in the contours for the 8 and 12 Hz cases. The deviation of the point of occurrence of maximum velocity in a radial profile was found to be about 6.5 degrees. Entrance velocity profiles showed symmetry for the straight tube inlet but were skewed for the bent tube inlet. Contour plots of the phase averaged axial turbulence intensity for bent tube cases showed higher values in the core and near the wall in the region of impingement. Axial turbulence intensity measured for the straight tube case showed features as observed in an axisymmetric sudden expansion flow. Dissert. Abstr.

N91-12028 Michigan Univ., Ann Arbor.
STRUCTURE AND MIXING PROPERTIES OF THE NEAR-INJECTOR REGION OF NONEVAPORATING PRESSURE-ATOMIZED SPRAYS Ph.D. Thesis
Gary Allen Ruff 1990 229 p
Avail: Univ. Microfilms Order No. DA9023631

A theoretical and experimental study of the dense-spray region of pressure-atomized nonevaporating sprays is described, emphasizing flows in the wind-induced and atomization breakup regimes. Large scale water jets were injected vertically downward into still air at atmospheric pressure. Injectors producing fully-developed turbulent pipe flow and slug flow exit conditions were considered. The applicability of the locally-homogeneous flow (LHF) approximation to predict flow properties in the near-injector region was also evaluated. It was found that mixing was strongly influenced by the degree of flow development at the injector exit as well as the breakup regime. The structure of the flow in the atomization breakup regime consisted of a liquid core surrounded by a drop-containing mixing layer with the inner portion of the mixing layer containing large irregularly-shaped liquid elements and drops. Even though the mean liquid volume fraction was high near the axis, the gas-containing region is relatively dilute at each instant, suggesting that drop formation and secondary drop breakup dominate the process in the mixing layer-not drop collisions. The velocities of large drops are generally much larger than small drops and the gas throughout the mixing layer providing direct evidence of significant separated flow effects. Conditions required for secondary drop breakup were found to exist mainly near the liquid surface. The LHF analysis gave encouraging predictions of dense-spray properties in the near-injector region for atomization breakup, including representation of flow effects wherever liquid volume fractions were greater than approximately 0.2. It was effective at high liquid volume fractions. The LHF analysis underestimates the velocity of the larger drops in the mixing layer and overestimates the rate of development of the spray in the more dilute spray regions. Dissert. Abstr.

N91-12029 Illinois Univ. at Urbana-Champaign, Savoy.
AN EXPERIMENTAL INVESTIGATION OF COMPRESSIBLE, TURBULENT MIXING LAYERS Ph.D. Thesis
Steven George Goebel 1990 252 p
Avail: Univ. Microfilms Order No. DA9026190

Experiments were conducted using pressure measurements, schlieren photography, and velocity measurements with a two-component laser Doppler velocimeter (LDV) system. These diagnostic systems were developed for use with the mixing layer wind-tunnel facility. Many conditions were evaluated, and seven mixing layer cases were fully examined, with relative Mach numbers ranging from 0.40 to 1.97. The spatial development and similarity of the mixing layers were examined, as well as the entrainment process and the effects of particle dynamics. Analyses to predict the mean density profiles, mean transverse velocity profiles, shape of the kinematic Reynolds stress profiles, and entrainment mass fraction of a fully developed, compressible mixing layer were also developed. From the schlieren photographs, no organized, large-scale structures were observed to dominate the mixing layers. The development of the mixing layers required a Reynolds number (based on the freestream velocity difference and local mixing layer thickness) on the order of 10(exp 5). In the fully developed regions of the mixing layers, it was found that transverse turbulence intensities and normalized kinematic Reynolds stresses decreased with increasing relative Mach number like the decreases measured in normalized growth rate, while the streamwise turbulence intensities and kinematic Reynolds stress correlation coefficients remained approximately constant. By examining the LDV velocity measurements from particles with different response characteristics, it was shown that particle dynamics effects were not a problem with these measurements. Also, by measuring velocity profiles on both sides of the wind-tunnel midplane, it was found that the flow fields were reasonably two-dimensional.
Dissert. Abstr.

N91-12030 Michigan Univ., Ann Arbor.
NUMERICAL SIMULATIONS OF VORTEX INTERACTIONS WITH A FREE SURFACE Ph.D. Thesis
Dequan Yu 1990 123 p
Avail: Univ. Microfilms Order No. DA9023678

The interaction of two-dimensional vortex flows with a free surface and the interaction of surface waves with a vortex generated current are studied numerically using a combined vortex/boundary integral technique. The interaction is controlled by a Froude number, based on the vortical motion, and the geometric parameters describe the initial vortex configuration. The head-on collision of a vortex pair with the free surface and the large amplitude Kelvin-Helmholtz instability of a submerged shear-layer below the free surface are studied in considerable detail. Here the vorticity is modeled as point vortices, vortex sheets, and finite area vortex regions. In the large Froude number limit, the surface motion follows the vortical flow, but depends only weakly on the actual value of the Froude number. For low Froude numbers, the free surface remains almost flat, and the disturbances caused by the vortical flow decrease rapidly with Froude number. The physical circumstance, in which the surface wave is generated by a time dependent pressure load, is studied numerically with the multipole expansion technique (MET). For the strong interaction, which depends on both Froude number and the initial depth of

the vortex, the current generally stops the waves from passing; for the weak interaction, the current has only a small effect on the waves. Dissert. Abstr.

N91-12031 Arizona State Univ., Tempe.
ROTATING TURBULENT FLOW THROUGH A 180 DEG PIPE BEND Ph.D. Thesis
Mohammed Anwer 1989 271 p
Avail: Univ. Microfilms Order No. DA9018480

Detailed information about rotating turbulent flow through a 180 degree pipe bend was obtained. In this respect, nonrotating turbulent flow through a 180 degree pipe bend was also investigated. A bend with an inner radius of curvature of 18 inches, and a pipe-to-bend radius ratio of 0.077 was used for this study. Experiments were carried out with a Reynolds number of 50,000 based upon axial bulk-mean velocity, and pipe diameter. This corresponds to a Dean number of 13,874. Experiments were carried out only at one Swirl number of 1.0. Rotating wire technique was used to obtain the three components of mean velocity, and the six components of Reynolds stress. Hot-film anemometry was used to obtain the behavior of wall shear stress. The variable-interval time-averaging (VITA) technique was used to analyze the wall shear stress signal to obtain the behavior of sublayer bursting in the flow. Results for the nonrotating case indicate that a second vortical structure is generated in the latter half of the bend section. This additional cell is pressure driven, and is very weak. Even though earlier results, and the present wall static pressure results indicate that the flow relaxes from the effects of bend curvature within fifteen diameters downstream of the exit of the bend, turbulence quantities reveal that even at eighteen diameters downstream of the exit of the bend, the flow stays substantially perturbed. Results for the rotating case indicate that no Dean-type secondary cell is set up within the bend section. This is a consequence of the high swirl chosen for the experiment. The flow in the upstream and the downstream straight pipe is dominated by the swirl, rather than by bend curvature. Sublayer bursting results indicate that external influence has a major role on the bursting process. Both concave curvature and convex curvature affects the bursting frequency. Dissert. Abstr.

N91-12032 Clarkson Univ., Potsdam, NY.
THERMODYNAMICALLY CONSISTENT RATE-DEPENDENT MODELS FOR TURBULENCE Ph.D. Thesis
Showkat Jahan Chowdhury 1990 144 p
Avail: Univ. Microfilms Order No. DA9019336

A thermodynamically consistent anisotropic two-equation model for analyzing turbulent flows is developed. In the first part of the study, based on the stress transport model, a rate-dependent algebraic expression for the Reynolds stress tensor is developed. It is shown that the new model includes the normal stress effects, exhibits viscoelastic behavior, and is compatible with the recently developed improved models of turbulence. Furthermore, the model is also consistent with the limiting behavior of turbulence in the inertial sublayer and is capable of predicting secondary flows in noncircular ducts. In the second part, the averaged basic balance laws for the mean turbulent motion for an incompressible fluid are considered. Based on the averaged entropy inequality an anisotropic rate-dependent constitutive equation for the turbulent stress tensor is formulated, and the constraints on material coefficients are described. Thermodynamically consistent transport equations for the time, frequency, and dissipation scales of turbulence are also developed. It is shown that the resulting model contains the available rate-dependent algebraic stress models as special limiting cases. The TEACH code is modified to simulate several turbulent flow fields. These include flows in a channel, behind a plane backward facing step, a two-dimensional two-stream mixing layer, and swirling and non-swirling flows through a pipe with sudden axisymmetric expansion. The predicted results are compared with the available experimental data and those evaluated by the existing two-equation turbulence models. The presented results show that the rate-dependent model is capable of describing general features of the mean turbulent motions including its normal stress differences. Dissert. Abstr.

N91-12033*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
SPURIOUS FREQUENCIES AS A RESULT OF NUMERICAL BOUNDARY TREATMENTS Final Report
Saul Abarbanel and David Gottlieb (Brown Univ., Providence, RI.) Oct. 1990 29 p Submitted for publication
(Contracts NAS1-18605; N00014-86-K-0754; AF-AFOSR-0093-90; NSF DMS-88-10150)
(NASA-CR-187457; NAS 1.26:187457; ICASE-90-73) Avail: NTIS HC/MF A03 CSCL 20D

The stability theory for finite difference Initial Boundary-Value approximations to systems of hyperbolic partial differential equations states that the exclusion of eigenvalues and generalized eigenvalues is a sufficient condition for stability. The theory, however, does not discuss the nature of numerical approximations in the presence of such eigenvalues. In fact, as was shown previously, for the problem of vortex shedding by a 2-D cylinder in subsonic flow, stating boundary conditions in terms of the primitive (non-characteristic) variables may lead to such eigenvalues, causing perturbations that decay slowly in space and remain periodic time. Characteristic formulation of the boundary conditions avoided this problem. A more systematic study of the behavior of the (linearized) one-dimensional gas dynamic equations under various sets of oscillation-inducing legal boundary conditions is reported. Author

N91-12034*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A STUDY OF VOID EFFECTS ON THE INTERLAMINAR SHEAR STRENGTH OF UNIDIRECTIONAL GRAPHITE FIBER REINFORCED COMPOSITES
Kenneth J. Bowles and Stephen Frimpong Oct. 1990 32 p
(NASA-TM-103267; E-5704; NAS 1.15:103267) Avail: NTIS HC/MF A03 CSCL 20D

A study was conducted to evaluate the effect of voids on the interlaminar shear strength (ILSS) of a polyimide matrix composite system. The graphite/PRM-15 composite was chosen for study because of the extensive amount of experience that has been amassed in the processing of this material. Composite densities and fiber contents of more than thirty different laminates were measured along with ILSS. Void contents were calculated and the void geometry and distribution were noted using microscopic techniques such as those used in metallography. It was found that there was a good empirical correlation between ILSS and composite density. The most acceptable relationship between the ILSS and density was found to be a power equation which closely resembles theoretically derived expressions. An increase in scatter in the strength data was observed as the void content increased. In laminates with low void content, the void appears to be more segregated in one area of the laminate. It was found that void free composites could be processed in matched metal die molds at pressures greater than 1.4 and less than 6.9 MPa. Author

N91-12035 Newcastle-upon-Tyne Univ. (England).
THE EFFECT OF ROTATIONAL OSCILLATION ON VORTEX SHEDDING FOR A CIRCULAR CYLINDER IN UNIFORM FLOW Ph.D. Thesis
Danny Ngar Man Kwan 1989 308 p
Avail: Univ. Microfilms Order No. BRDX89722

Force measurements were carried out for cylinders with rotational oscillation about their longitudinal axes in a uniform flow over ranges of oscillating amplitudes and frequencies. The behavior of the hydrodynamic forces as functions of the amplitude and reduced velocity are close to those of the classic transverse oscillation. Lock-on at the fundamental and higher harmonics were observed in rotational oscillations. High frequency motion was found to suppress the natural vortex formation; it also results in the shedding of vortices at the driving frequency with reduction in the mean drag force and high oscillatory drag component. Low frequency oscillation demonstrates the absence of sub-harmonic lock-on with the resultant forces near the rigid cylinder values. Flow visualization studies of the wake show that the primary lock-on characteristics for transverse oscillation are reproduced in rotational

oscillation. The results confirm the claim by many researchers that the transverse oscillation of a cylinder, in a uniform flow over the primary lock-on, is analogous to a cylinder with rotational oscillation about its axis. Tests on a cylinder with trip wires show a shift in the mean lift force. A simple discrete vortex model was developed and simulates correctly many of the flow characteristics for a rigid cylinder at high Reynolds number. The model combines the techniques of surrounding the cylinder with ring vortices and the efficient Cloud-in-Cell algorithm. It was also extended to include the effect of rotational oscillation and gives satisfactory agreement with experimental measurements over the primary and post-lock-on range. Dissert. Abstr.

N91-12036 Utah Univ., Salt Lake City.
INTERNAL FLOW ANALYSIS WITH A PREDICTIVE MODEL FOR DROPLET SIZE DISTRIBUTION Ph.D. Thesis
Saeed Bonabian 1990 179 p
Avail: Univ. Microfilms Order No. DA9027482

The objectives are: (1) to develop a methodology using an accurate and effective computer code to solve the boundary layer equations for coupled laminar and turbulent two dimensional internal flows, and (2) to use a reliable predictive model for the mean droplet size and size distribution in annular droplet flow. The code was developed using the Keller Box method to solve the energy equation for external flows. The results obtained using this code are proved to be sufficiently accurate. In order to come up with a model for the droplet size and size distribution, an extensive survey of the experimental data and existing models was carried out. In the chosen correlation, it is postulated that the majority of the droplets are generated at the time of entrainment and the size distribution is the direct reflection of the droplet entrainment mechanism based on roll-wave shearing off. This correlation is strongly dependent on the gas Reynolds numbers. The properties of the gas and the velocity profiles are calculated using the developed code. The calculated maximum droplet size and size distribution are within the range of the experimental data. Dissert. Abstr.

N91-12037 California Univ., Berkeley.
THE INFLUENCE OF CURVATURE AND BUOYANCY IN THREE-DIMENSIONAL PIPE FLOWS Ph.D. Thesis
Douglas John Goering 1989 325 p
Avail: Univ. Microfilms Order No. DA9028837

The influence of pipe curvature and buoyancy in steady laminar pipe flows is examined. The cross-stream motion which is generated by each of these influences is responsible for increased heat transfer and frictional losses. Characteristics of the flow vary strongly with the absolute and relative strengths of buoyancy and curvature. The orientation examined is that of a horizontal pipe coil in which the combination of pipe curvature and buoyancy generate non-symmetric cross-stream flow. Results are obtained via a fully-elliptic three-dimensional numerical calculation of the flow. Two separate issues are examined in the context of fully-developed flows. The first of these concerns the solution multiplicity which is known to exist in pipe flows that are affected by curvature or buoyancy. The results indicate that some of the previously observed solutions are unstable to anti-symmetric perturbations. The second issue concerns the range of forced, free, and mixed convection which results from curvature, buoyancy, or both influences, respectively. The results help to settle discrepancies which currently exist and provide new data for pipes with low thermal conductivities. The new data reveal a three-dimensional fully-developed flow under certain circumstances. Developing flows are examined for three types of wall boundary conditions and two inlet conditions. Results for the constant wall temperature case display a transfer from buoyancy-dominated to curvature-dominated flow as the entrance region is passed. For constant wall heat flux conditions, buoyancy and curvature maintain a similar relative influence throughout the developing and fully-developed region. Dissert. Abstr.

N91-12038 Houston Univ., TX.
A NUMERICAL STUDY OF UNSTEADY FLOWS PAST A CIRCULAR CYLINDER Ph.D. Thesis
Xuegeng Wang 1989 212 p
Avail: Univ. Microfilms Order No. DA9026379

A finite difference study of unsteady flow past a circular cylinder is presented. The governing equations are expressed in vorticity/stream-function variables and solved in a transformed plane, which concentrates the mesh system near the cylinder surface with the mesh size increasing with increasing radial distance in the physical plane. The boundary conditions on the surface of the cylinder are the no-slip, no-penetration conditions. The conditions at large values of r are that the flow is not disturbed by the presence of the cylinder. The governing equations are solved using a predictor-corrector scheme for the vorticity-transport equation and a Fast Poisson Solver for the vorticity/stream function equation. The convective terms in the vorticity-transport equation are represented by both a central-difference approximation for the low Reynolds number (Re) and low Keulegan-Carpenter number (KC) flows and a mixed central-difference/upwinding procedure for intermediate values of Re and KC. The solution procedure and technique was validated for several types of unsteady flows. Excellent agreement with flow visualization and experimentally determined drag and lift coefficients was obtained for both symmetric and asymmetric wake solutions. Dissert. Abstr.

N91-12039# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Dienstleistungsbereich.
IN ORBIT PERFORMANCE OF THE TV-SAT/TDF-1 HEAT PIPE SYSTEM
R. Schlitt, R. Meyer, R. Giovannini, and G. Cluzet (Aerospatiale, Cannes, France) 1990 18 p
(MBB-UO-0098-90-PUB; ETN-90-97886) Avail: NTIS HC/MF A03

The large heat pipe system developed for a new generation of direct broadcasting satellites of the TV-SAT/TDF family is described. The system consists of 88 axial grooved heat pipes of the aluminum/ammonia type. The design and development phases are summmarized and in-orbit data of satellites are reviewed and compared. A discussion of the lessons learnt aspect of the program is given. ESA

N91-12040# Washington Univ., Seattle. Dept. of Environmental Health.
USE OF POWER BALANCE TO MODEL CONVERGING FLOWS IN BILATERAL JUNCTIONS FOR VENTILATION SYSTEMS M.S. Thesis
James Patrick Curran 1990 148 p Sponsored by AFIT, Wright-Patterson AFB, OH
(AD-A224684; AFIT/CI/CIA-90-043) Avail: NTIS HC/MF A07
CSCL 13/1

The power balance method and the linear kinetic power model provide one method of estimating the distribution of flows and the losses in a junction. The power balance model is an application of the law of conservation of energy to determine the energy change per unit time (i.e., power) for conditions typical in converging flow junctions. The linear kinetic power model assumes that the power losses in any junction are related linearly with the kinetic powers of each branch entering the junction. The kinetic power model should theoretically apply to bilateral junction but only single lateral junctions have been tested with this method. There are many practical applications for bilateral junctions; but, in the absence of data for design, their use is problematic. Bilateral junctions may provide economic benefits; however, the potential costs of using these junctions (i.e., increased pressure requirements, increased settling, etc.) are not currently known. The primary goal was to characterize the flow in a bilateral junction and to determine if the kinetic power model could be successfully applied to predict power losses. If successful, similar research could be completed on many bilateral junctions with various geometric variables to develop a general model applying to a wide range of bilateral junctions as has been done with single lateral junctions. A secondary goal was to test the hypothesis

that the power losses for three flows joined at a bilateral junction are not significantly different than the combined power losses of identical flows joined by two single lateral junctions. GRA

N91-12041# Westinghouse Electric Corp., Middletown, RI. Naval Systems Div.
EFFECTS OF STREAMWISE PRESSURE GRADIENTS ON TURBULENCE STRUCTURE IN THE VISCOUS LAYER Annual Technical Report, 14 Jul. 1989 - 13 Jul. 1990
Donald M. McEligot and Helmut Eckelmann (Max-Planck-Inst. fuer Stroemungsforschung, Goettingen, Germany, F.R.) 13 Jul. 1990 104 p
(Contract N00167-89-C-0048)
(AD-A225048; WNSD/HYDRO-90-03) Avail: NTIS HC/MF A06 CSCL 20/4

In order to provide bases for hydroacoustic models predicting wall pressure fluctuations in turbulent boundary layers, time series measurements with an X-probe and a wall shear stress sensor were obtained simultaneously in an oil channel both for fully-developed and for laterally-converging flows. Data were concentrated in the viscous layer at y = 5, 7, 10, 15, 25 and centerplane for K sub p = (nu/rho u-cubed)dp/dx = -0.008 to -0.02 (slight to highly favorable pressure gradients). Results presented include comparisons of the profiles of the mean statistics, plus correlations, of u, v, uv and t sub w. The mean profile u (y) increased and the correlation coefficients Ruu (y approx 15, tau*), Ruv (15 tau*) and R sub(u tau) (15, tau*) broadened with an increase in the magnitude of K sub p over this range. However, the turbulence statistics u'(y)/ut, v'(y)/u, S sub u (y) and F sub u (y) as well as the maximum amplitudes of R sub uv (15, tau) and R sub u tau (15, tau) suffered no significant effect. GRA

N91-12042# Colorado Univ., Boulder.
PATTERN SELECTION, WAVE FORMATION, TURBULENCE, AND VORTEX BREAKDOWN IN SPIRAL FLOWS Annual Progress Report, 1 Jan. - 30 Sep. 1990
Duane P. Sather 1 Jan. 1990 4 p
(Contract N00014-90-J-1336)
(AD-A225068) Avail: NTIS HC/MF A01 CSCL 20/4

The major effort was devoted to a study of time dependent transition solutions connecting steady state solutions of the Navier-Stokes equations and to the development of a theory of periodic waves and turbulence in rotating viscous fluids. The results obtained include an analytic description of the difference between primary and secondary flows of a viscous fluid, the existence of a continuum of periodic waves in rotating plane Couette flow, and an analytic description of a mechanism to generate the turbulent-like flows observed in experiments on rotating spiral flows. GRA

N91-12043# Arizona State Univ., Tempe. Dept. of Mechanical and Aerospace Engineering.
THREE-DIMENSIONAL UNSTEADY SEPARATION AT LOW REYNOLDS NUMBERS Final Report
Helen L. Reed Jul. 1990 292 p
(Contract N00014-86-K-0066)
(AD-A225167) Avail: NTIS HC/MF A13 CSCL 20/4

A procedure was generated to analyze the boundary layer on airfoils experiencing unsteady flight conditions and to predict the changes in the performance characteristics during off-design. The method predicts the flow in the boundary-layer region near the separation bubble using the incompressible Navier-Stokes equations with boundary conditions from inviscid and laminar boundary-layer solutions. The rate at which the separation bubble develops and decays is of primary interest in this study. Unsteady surface-pressure-coefficient distributions and velocity profiles are presented. The experimental effort involved the study of three-dimensional unsteady separation under low-Reynolds-number conditions. The test geometry consisted of channel with a suction patch on the opposite wall. Contributions from the numerical effort include a novel, robust adaptive-rigid technique for incompressible flow. Additional contributions from the experiments include a database for comparison with theory computations. GRA

N91-12044# Universiteit Twente, Enschede (Netherlands).
MEASUREMENTS ON CONCENTRATION WAVES IN BUBBLY LIQUIDS Ph.D. Thesis
Cornelis Kapeteijn 1989 112 p Sponsored by Netherlands Technology Foundation and Koninklijke/Shell-Lab., Amsterdam, Netherlands
(ISBN-90-9003146-4; ETN-90-97772) Copyright Avail: NTIS HC/MF A06

Gas-liquid two phase flow is studied. Properties of a single rising bubble and a mixture of bubbles under stationary conditions as experienced during experimentation are described. The instruments and the setup of an experimental loop are described. A theoretical description of a propagation of void fraction transitions in the bubble flow regime are described. Preliminary findings of the transition to plug flow are described. Detailed conclusions and recommendations are given. ESA

N91-12045# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
FLOWS IN A FREE EXPANSION NOZZLE Thesis [STROEMUNGEN IN EINER FREIEN EXPANSIONSDUESE]
Klaus Hampel 30 Mar. 1990 121 p In GERMAN
(MBB-UK-0088-90-PUB; ETN-90-97853) Avail: NTIS HC/MF A06

The future transport systems of space travel will carry their load in space, according to aerothermodynamics. The advantages of such systems compared to missiles come from the notably bigger payloads, the launching site flexibility, the better temporary availability, and the re-use ability. Such a system called SAENGER is being discussed in Germany. The propulsion is the central problem of the system. The quality of engine inlet and the expansion nozzle are of decisive importance for the practibility of the project. Several fundementally different concepts, whose efficiency has to be determined, were discussed for the expansion nozzle. Two different nozzle concepts are compared: the plain nozzle and the rotation symmetrical plug nozzle. The two dimensional and two dimensional symmetrical flow fields must be calculated with the Euler and Navier-Stokes processes. ESA

N91-12046# European Space Agency, Paris (France).
SOLUTION OF COMPRESSIBLE TIME-DEPENDENT NAVIER-STOKES EQUATIONS BY CHEBYCHEV SPECTRAL METHODS
Patrice Loisel (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) Aug. 1990 97 p Transl. into ENGLISH of Resolution des Equations de Navier-Stokes Compressibles Instationnaires par Methode Spectrale de Tchebycheff (Paris, France, ONERA), 1987 60 p Original language document was announced as N89-27126
(ESA-TT-1160; ONERA-NT-1987-1; ETN-90-98007) Avail: NTIS HC/MF A05

Navier-Stokes equations are numerically solved for two and three dimensional time dependent compressible flows where high gradient zones are present. Two different numerical treatments of these zones are proposed. A hybrid spectral-finite difference method is proposed for solving the Navier-Stokes equations for flow far from walls. The feasibility of the method is demonstrated by results obtained for test cases with inviscid flow. For confined boundary layer flow, a spectral method based on the use of predictor-corrector schemes is presented. Results for two and three dimensional flow with simple geometries are given. ESA

N91-12047# European Space Agency, Paris (France).
THEORETICAL AND EXPERIMENTAL STUDY OF HOMOGENEOUS ROTATING TURBULENCE
Laurent Jacquin (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) Aug. 1990 221 p Transl. into ENGLISH of Etude Theorique et Experimentale de la Turbulence Homogene en Rotation (Paris, France, ONERA), 1988 176 p Original language document was announced as N89-29724
(ESA-TT-1170; ONERA-NT-1988-7; ETN-90-98008) Avail: NTIS HC/MF A10

Turbulence in solid body rotation is generated by passing a

flow of air through a rotating cylinder containing a dense honeycomb structure and a turbulence producing grid. The velocity field downstream from this arrangement is investigated by hot wire probes. It is shown that the rotation mainly affects the components normal to the rotation axis and that these effects are triggered when the Rossby numbers constructed from macroscopic turbulent quantities are less than unity. These results are related by a spectral approach to the mechanisms of transition towards two dimensional turbulence. ESA

N91-12048# Institut Franco-Allemand de Recherches, Saint-Louis (France).
PARTICLE ADDITIVE EFFECT ON HEAT TRANSFER CAUSED BY SHOCK- AND PISTON-INDUCED TURBULENT BOUNDARY LAYER IN SHOCK TUBE
F. Seiler 13 Jul. 1989 13 p Presented at 17th International Symposium on Shock Waves and Shock Tubes, Bethlehem, PA, 17-21 Jul. 1989
(Contract BMVg-T/R-760/I-0014/I-1714)
(ISL-CO-224/89; ETN-90-98033) Avail: NTIS HC/MF A03

The influence of additive particles seeded into a flow on the heat transfer to a wall surface is investigated. Titanium dioxide particles were entrained into a shock induced and a piston induced turbulent boundary layer affected flow field. The experiments were performed in a rectangular test section, which was mounted at the end of a high pressure shock tube. It was found that the initial particle mass loading and the particle traveling distance influence the particle to gas mass (rate) ratio, which eventually controls the particles potential for heat transfer reduction in the two phase flow. ESA

N91-12049# Institut Franco-Allemand de Recherches, Saint-Louis (France).
TURBULENT BOUNDARY LAYER INFLUENCE ON THE FLOW FIELD BEHIND A SHOCK WAVE IN A SHOCK TUBE
F. Seiler, J. Srulijes, and G. Mathieu 17 Jul. 1989 13 p Presented at 17th International Symposium on Shock Waves and Shock Tubes, Bethlehem, PA, 17-21 Jul. 1989
(ISL-CO-225/89; ETN-90-98034) Avail: NTIS HC/MF A03

The influence of turbulent boundary layer growth on flow formation in the driven gas of a shock tube with circular cross section was investigated. The boundary layer disturbed velocity field downstream of a shock wave was characterized by a potential function that in a shock fixed coordinate system describes the post shock velocity field by small perturbations of the Rankine-Hugoniot velocity. For the boundary layer, Mirels boundary layer theory was applied with a velocity profile depending on the exponent of 1/7. For comparing the solutions of the theoretical model with experimental data the streamwise flow velocity was measured at different distances from the shock tube wall using a laser Doppler velocimeter. Theory and experiment are in good agreement and show a not negligible distortion of the post shock flow pattern by turbulent boundary layer development similar to the influence of the laminar boundary layer at low pressure. ESA

N91-12050# Institut Franco-Allemand de Recherches, Saint-Louis (France).
LASER-DOPPLER VELOCIMETER MEASUREMENTS OF SHOCK AND PISTON INDUCED TURBULENT BOUNDARY LAYER IN A SHOCK TUBE
J. Srulijes, F. Seiler, and G. Smeets 21 Jul. 1989 13 p Presented at 3rd International Conference on Laser Anemometry Advances and Applications, Swansea, Wales, 26-29 Sep. 1989
(ISL-CO-227/89; ETN-90-98036) Avail: NTIS HC/MF A03

Velocity measurements using the laser Doppler velocimeter were performed in a shock tube for obtaining information about the behavior of shock and piston induced turbulent boundary layers. The velocity distributions behind the incident shock wave and behind a shock accelerated piston inside the turbulent boundary layer were investigated at different distances from the tube wall surface. A comparison of the experimental data with theoretical calculations is made. The experimentally determined velocity profiles are found to be in good agreement with the theories applied for the shock boundary layer, and the piston boundary layer formation respectively. ESA

N91-12051# Applied Research Lab., State College, PA.
LARGE FLAT PLATE TURBULENT BOUNDARY LAYER EVALUATION
H. L. Petrie, A. A. Fontaine, S. T. Sommer, and T. A. Brungart 18 May 1990 38 p
(Contract N00039-88-C-0051)
(AD-A225316; PSU/ASL/TM-89-207) Avail: NTIS HC/MF A03 CSCL 20/4

The flow characteristics of a 3.1m long by 1.22m span large flat plate mounted in the test section of the ARL Penn State 48-inch diameter water tunnel were evaluated. The turbulent boundary layer over the central 50 percent of the span of the plate was fully developed, 2-D and has a near zero streamwise pressure gradient. One component laser Doppler velocimeter measurements were made at four freestream velocities and at nine streamwise locations on the plate. Resulting friction velocities on the plate varied from 0.175 to 0.45 m/s, approximately. Reynolds numbers, based on streamwise distance from the boundary layer virtual origin, ranged from 4.5 million to 33.5 million. Momentum thickness Reynolds numbers ranged from 6570 to 39,000. This range of momentum thickness Reynolds number is uniquely large for a laboratory flow. GRA

N91-12052# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
OBSERVATIONS OF THE DYNAMICS AND ACOUSTICS OF TRAVELLING BUBBLE CAVITATION Ph.D. Thesis Final Report, 1986 - 1990
Steven Louis Ceccio 25 Jun. 1990 182 p Sponsored in part by Francis J. Cole Foundation and ARCS Foundation
(Contracts N00014-85-K-0597; N00014-85-K-0397)
(AD-A225375; ENG-249-11) Avail: NTIS HC/MF A09 CSCL 20/1

Individual travelling cavitation bubbles generated on two axisymmetric headforms were detected using a surface electrode probe. The growth and collapse of the bubbles, almost all of which were quasi-spherical caps moving close to the headform surface, were studied photographically. Although the growth patterns for the two headforms were similar, the collapse mechanisms were quite different. These differences were related to the pressure fields and viscous flow patterns associated with each headform. Measurements of the acoustic impulse generated by the bubble collapse were analyzed and found to correlate with the maximum volume of the bubble for each headform. Numerical solutions of the Rayleigh-Plesset equation were generated for the same flows and compared with the experimental data. The experiments revealed that for smaller bubbles the impulse-volume relationship is determinate, but for larger bubbles the impulse become more uncertain. The theoretical impulse was at least a factor of two greater than the measured impulse, and the impulse-volume relationship was related to the details of the collapse mechanism. Acoustic emission of individual cavitation events was spectrally analyzed and the results were compared with relevant theoretical and emperical predictions. Finally, the cavitation nuclei flux was measured and compared to the cavitation event rate and the bubble maximum size distribution through the use of a simple model. GRA

N91-12053# Rensselaer Polytechnic Inst., Troy, NY.
AN AUTOMATED SYSTEM FOR MEASURING THE MASS FLOWRATE OF POWDERS IN TRANSPORT LINES Final Report, Sep. 1988 - Sep. 1989
Howard Littman, Morris B. Morgan, III, Demetrios K. Prapas, and Glen O. Rubel (Chemical Research and Development Center, Aberdeen Proving Ground, MD.) Aug. 1990 23 p
(Contract DAAA15-86-K-0016)
(AD-A225560; CRDEC-TN-013) Avail: NTIS HC/MF A03 CSCL 15/5

A new automated particle transport (APT) system has been

developed for studying the dissemination of bulk powders into deagglomerated aerosols. It consists of a 1.12-inch ID transport line with a spout-fluidized bed feeder. The particles are transported from an aerated annulus into the transport line and collected in a closed can or bag filter. Two separate feed lines supply the air necessary to operate the transport line and aerate the particles in order that they flow smoothly into the transport line. An IBM PC AT computer clone equipped with a data translation DT 2806 multifunction input-output board and A to D and D to A modules (DTX 311 and 328) is used for both control and data acquisition. A fluid mechanical model of the flow has been developed and the APT system will be used to verify it. Experiments will be conducted to measure the choking velocity, drag coefficient, fluid and particle flowrates, and pressure distribution in the line. GRA

N91-12054# Levy (Salomon), Inc., Campbell, CA.
DESIGN OF A MODULAR TEST LOOP FOR STUDY OF TWO-PHASE FLOW AND HEAT TRANSFER IN LOW AND HIGH ACCELERATIONS Final Report, Sep. 1989 - Apr. 1990
Davood Abdollahian Jul. 1990 123 p
(Contract F33615-89-C-3403; AF Proj. 3005)
(AD-A225658; SLI-9008; WRDC-TR-90-3046) Avail: NTIS HC/MF A06 CSCL 20/4

Thermal management systems using two-phase heat transfer loops are being developed for application on future spacecraft operating at high power levels. Design of these systems requires a knowledge of two-phase flow and heat transfer in microgravity and high acceleration environments. In addition to the two-phase flow parameters, several criteria including heat transfer boundaries and instability mechanisms are expected to be strongly dependent on the acceleration levels. These should be analyzed in detail and experimentally verified. The overall objective of this program was to identify the parameters and criteria of immediate importance of design of two-phase systems and to develop the conceptual design for a modular two-phase loop which can be used to generate the necessary data. A survey of existing and ongoing efforts was performed to identify the areas that need more testing, and to select the two-phase flow models which could be used in the design analysis. A preliminary design for a baseline configuration was completed which is intended to perform the defined experiments at earth gravity and aboard an airplane in Keplerian trajectory. This effort consisted of fluid selection, design analysis, and specification of the test matrix. GRA

N91-12055# Wright State Univ., Dayton, OH. Dept. of Mechanical and Materials Engineering.
ANALYSIS OF TRANSIENT AND START-UP BEHAVIOR OF HEAT PIPES AND AN ENERGY STORAGE MODULE Interim Report, Jan. - Dec. 1989
Amir Faghri Jun. 1990 237 p
(Contract F33615-88-C-2820; AF Proj. 3145)
(AD-A225659; WSU-TR-88-001; WRDC-TR-90-2031) Avail: NTIS HC/MF A11 CSCL 20/13

The objective of this report is to examine the steady, transient, and start-up behavior of heat pipes as well as a transient analysis related to a thermal energy storage module. A detailed experimental and numerical analysis of low temperature heat pipes with multiple heat sources is also performed. The performance of a thermal energy module is simulated numerically. The change of phase of the phase-change material (PCM) and transient forced convective heat transfer for the transfer fluid with a low Prandtl number are solved simultaneously as a conjugate problem. The start-up process of a frozen heat pipe is described and a complete model for the start-up of the frozen heat pipe is developed based on the existing experimental data, which is simplified and solved numerically. Finally, a unique and efficient transient two-dimensional compressible analysis of high temperature heat pipes with a pulsed heat input is given. GRA

N91-12056# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Hubschrauber und Flugzeuge.
VERIFICATION OF THE NSFLEX PROCESS WITH DIFFERENT TEST CASES [VERIFIKATION DES NSFLEX-VERFAHRENS AN VERSCHIEDENEN TESTFAELLEN]
O. Schmidt-Nechl 23 Jan. 1990 97 p In GERMAN
(MBB/FE122/S/PUB/390; ETN-90-97842) Copyright Avail: NTIS HC/MF A05

The Navier-Stokes solver using characteristic Flux Extrapolation (NSFLEX) process, an implicit Navier Stokes solver, was checked for the special case of flat plates. The comparisons with reference solutions were in good agreement with the compressible BLASIUS solution, and gave comparable values with the turbulence measurements, as long as the systems were in an adequately vertical position to the surface. The following examinations showed that the constancy of the total enthalpy was secured, that the modified crossed derivatives brought no improvement, that the viscosity derivatives with a three and four order discretization accuracy gave worse results for the chosen test examples, that the original two order derivative, so that the changes carried out for the turbulence model made the program unstable, without bringing noticeable increase in accuracy. ESA

N91-12057# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.). Abt. fuer Grenzschichten und Unterschallstroemungen.
EXPERIMENTAL INVESTIGATION OF CROSS-FLOW INSTABILITY IN THE LINEAR AND NON-LINEAR STAGE OF THE TRANSITION REGION Ph.D. Thesis - Karlsruhe Univ.
Bernhard Mueller Feb. 1990 115 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1237) Original contains color illustrations
(DLR-FB-90-09; ISSN-0171-1342; ETN-90-98039) Copyright Avail: NTIS HC/MF A06; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 37 Deutsche marks

Linear and nonlinear steps of the laminar turbulent transition in 3-D boundary layers are experimentally investigated by hot wire anemometry. The instability modes were examined with consideration to wavelength, frequency range, eigenfunction and amplification and showed a nonlinear saturation. Nonlinear interactions between stationary vortices and traveling waves were experimentally observed. For the calculation, the quasi 2-D flow approximation was used as in the Nitschke-Kousky model. The results have a better accordance with the linear theory in the case of high turbulence degrees. The variations of the sweep angle and the free steam velocity show the tendency predicted by the linear stability theory but nonlinear effects dominate under these conditions. ESA

N91-12058# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Abt. Aerodynamik der Turbomaschine.
A COMPUTER PROGRAM SYSTEM FOR THE ANALYSIS OF THREE-DIMENSIONAL STEADY FLOWS IN TURBOMACHINERY COMPONENTS Ph.D. Thesis - Ruhr Univ.
Wolfgang Hoffmann Mar. 1990 161 p In GERMAN; ENGLISH summary Original contains color illustrations
(DLR-FB-90-18; ISSN-0171-1342; ETN-90-98041) Copyright Avail: NTIS HC/MF A08; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 69 Deutsche marks

A modular program system to calculate viscous flows in turbomachine components is presented. Local flow phenomena such as boundary layers, secondary flows and shock waves were analyzed. The system can generate and display computing grids for axial and radial turbomachines. An explicit/implicit scheme to calculate 3-D Reynolds averaged Navier-Stokes equation with algebraic turbulence model was implemented. A subroutine system for data interpretation and flow visualization was included. As example a high pressure radial compressor solution was presented. Particular consideration was given to secondary flow analysis. ESA

N91-12059# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.). Abt. Instabilitaeten und Abloesung.
A MATHEMATICAL-PHYSICAL MODEL FOR DESCRIBING TRANSITIONAL BOUNDARY LAYER FLOWS. VOLUME 1: THE LINEAR AND NONLINEAR DISTURBANCE DIFFERENTIAL EQUATIONS
Thomas M. Fischer Mar. 1990 69 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1242)
(DLR-FB-90-24-Vol-1; ISSN-0171-1342; ETN-90-98046)
Copyright Avail: NTIS HC/MF A04; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 28 Deutsche marks

The linear and nonlinear disturbance differential equations which depict the stability of locally parallel, 2-D and 3-D boundary layer flows are analyzed. The spectrum of the linear operator as well as the asymptotic behavior of periodic solutions of the nonlinear system in the vicinity of the critical Reynolds number are investigated. A Landau equation, coupled with an inhomogeneous heat equation, is obtained for determining the amplitude of the disturbance and the nonlinear distortion of the mean flow. As an example, stationary perturbations in 3-D boundary layers due to the crossflow instability are considered. ESA

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N91-12060# National Inst. of Standards and Technology, Gaithersburg, MD.
DEVICE AND METHOD FOR PROVIDING ACCURATE TIME AND/OR FREQUENCY Patent Application
David W. Allan, inventor (to NIST), Judah Levine, inventor (to NIST), Dickie D. Davis, inventor (to NIST), and Marc A. Weiss, inventor (to NIST) 29 Jan. 1990 37 p
(US-Patent-Appl-SN-471764; PB90-238064) Avail: NTIS HC/MF A03 CSCL 14D

A device and method are disclosed in the patent application for providing an accurate output from a unit, such as an oscillator and/or clock providing an output indicative of frequecy and/or time. The device includes a processing section having a microprocessor that develops a model characterizing the performance of the device, including establishing predicted accuracy variations, and the model is then used to correct the unit output. An external reference is used to provide a reference input for updating the model, including updating of predicted variations of the unit, by comparison of the reference input with the unit output. The ability of the model to accurately predict the performance of the unit improves as additional updates are carried out, and this allows the interval between the updates to be lengthened and/or the overall accuracy of the device to be improved. GRA

N91-12061 Minnesota Univ., Minneapolis.
INLINE PARTICLE HOLOGRAPHY APPLIED TO FLUID VELOCITY MEASUREMENT Ph.D. Thesis
Scott Jarrett Forbes 1989 166 p
Avail: Univ. Microfilms Order No. DA9019061

The feasibility of a new application of particle displacement holography is investigated. This application uses photographic thresholding to optically process the information in the reconstructed image, and thus obtain the local velocity magnitudes and angles. The study consists of three main parts: development of theoretical intensity field, measurement of the intensity field to validate the theory, and experimental measurement of a natural convection flow field. To assess the viability of the technique, an analytical solution of the intensity distribution in the reconstructed image of an in-line Fraunhofer particle hologram is derived. The results of this solution are presented as surface and contour plots of the calculated intensity distribution. The primary conclusion from these predictions is that photographic thresholding alone will be limited to discerning at most twenty-five planes of two-dimensional information from a given test section. The analytical solution is validated by recording the single exposure holograms of long wires. Finally, the complete application of the technique, from start-to-finish, is demonstrated. The flow field measured is the natural convection in a horizontal annulus between concentric cylinders, at a Rayleigh number of 10,000. Neutrally buoyant particles are seeded into the fluid, and the measured particle trajectories are used to infer the fluid velocities. The first scenario consists of the two-dimensional flow in an unobstructed annulus. A second quasi-three-dimensional flow is then studied, in which three radial fins are placed along half of the test section length. Measurements are obtained in both the finned and the un-finned sections of the test section from the same holographic plate. The results of these two scenarios are compared with theoretical predictions of the fluid velocity field. Dissert. Abstr.

N91-12062 Stanford Univ., CA.
DYNAMICALLY TESTING OF GP B ELECTROSTATICALLY LEVITATED SPHERICAL GYROSCOPES Ph.D. Thesis
Salah El-Din Feteih 1990 150 p
Avail: Univ. Microfilms Order No. DA9017843

Gravity Probe B (GP B) is an ongoing project to test Einstein's general theory of relativity. The objective is to detect and to measure the geodetic and frame-dragging effects exhibited by an Earth-orbiting spinning gyroscope. The general theory of relativity predicts that the first of these effects is 2.22 x 10(exp -7) deg/hr and the second is 1.43 x 10(exp -9) deg/hr. To attain the mission accuracy goal, gyroscopic precession due to Newtonian torques must not exceed 1.3 x 10(exp -11) deg/hr. The time histories of these signals is used to obtain the spin vector motion in the laboratory. This motion is used to estimate the mass unbalance and the inertia ratios of the gyroscope, and to obtain information on the coefficients of the gyroscope's higher harmonics in shape. Biases in the SQUIDs were calculated, and the spin vector trace inside the gyroscope is estimated. Techniques were developed to reliably measure the time history of the spin vector in the lab using two or three pick-up loops, using the signature of the magnetic trapped flux inside the gyroscope. Also described is the technique used to estimate the gyroscope's characteristics using precession information in the lab and in the body. Dissert. Abstr.

N91-12063*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
LASER TRANSIT ANEMOMETER MEASUREMENTS OF A JANNAF NOZZLE BASE VELOCITY FLOW FIELD
William W. Hunter, Jr., C. E. Russ, Jr., and J. I. Clemmons, Jr. (Vigyan Research Associates, Inc., Hampton, VA.) Aug. 1990 26 p
(NASA-TM-102725; NAS 1.15:102725) Avail: NTIS HC/MF A03 CSCL 14B

Velocity flow fields of a nozzle jet exhausting into a supersonic flow were surveyed. The measurements were obtained with a laser transit anemometer (LTA) system in the time domain with a correlation instrument. The LTA data is transformed into the velocity domain to remove the error that occurs when the data is analyzed in the time domain. The final data is shown in velocity vector plots for positions upstream, downstream, and in the exhaust plane of the jet nozzle. Author

N91-12064*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DROPSIZE CORRELATION FOR CRYOGENIC LIQUID-JET ATOMIZATION
Robert D. Ingebo Jul. 1990 8 p Presented at the 29th Aerospace Sciences Meeting, Reno, NV, 7-10 Jul. 1991; sponsored

in part by AIAA
(NASA-TM-103646; E-5828; NAS 1.15:103646; AIAA-91-0284)
Avail: NTIS HC/MF A02 CSCL 14B

Momentum transfer from high velocity nitrogen gas flow to liquid-nitrogen jets was investigated. A correlation of aerodynamic and liquid-surface forces with characteristic drop diameter was obtained for cryogenic liquid-jet breakup in Mach 1 gas flow. Nitrogen gas mass-flux was varied by using three differently sized two-fluid fuel atomizers with different nozzle diameters. Author

N91-12065# Argonne National Lab., IL. Electron Microscopy Center for Materials Research.
EVOLUTIONARY DEVELOPMENTS IN X RAY AND ELECTRON ENERGY LOSS MICROANALYSIS INSTRUMENTATION FOR THE ANALYTICAL ELECTRON MICROSCOPE
Nester J. Zaluzec 1990 11 p Presented at the 12th International Congress for Electron Microscopy, Seattle, WA, 12-18 Aug. 1990
(Contract W-31-109-eng-38)
(DE90-017799; CONF-900877-6) Avail: NTIS HC/MF A03

Developments in instrumentation for both X ray Dispersive and Electron Energy Loss Spectroscopy (XEDS/EELS) over the last ten years have given the experimentalist a greatly enhanced set of analytical tools for characterization. Microanalysts have waited for nearly two decades now in the hope of getting a true analytical microscope and the development of 300 to 400 kV instruments should have allowed us to attain this goal. Unfortunately, this has not generally been the case. While there have been some major improvements in the techniques, there has also been some devolution in the modern AEM (Analytical Electron Microscope). In XEDS, the majority of today's instruments are still plagued by the hole count effect, which was first described in detail over fifteen years ago. The magnitude of this problem can still reach the 20 percent level for medium atomic number species in a conventional off-the-shelf intermediate voltage AEM. This is an absurd situation and the manufacturers should be severely criticized. Part of the blame, however, also rests on the AEM community for not having come up with a universally agreed upon standard test procedure. Fortunately, such a test procedure is in the early stages of refinement. The proposed test specimen consists of an evaporated Cr film approx. 500 to 1000A thick supported upon a 3mm diameter Molybdenum 200 micron aperture. DOE

N91-12066# Wyoming Univ., Laramie. Dept. of Chemistry.
STUDIES OF THIN FILM CHEMICAL SENSORS USING THE QUARTZ CRYSTAL MICROBALANCE Ph.D. Thesis
Howard R. Meyer, Jr. Aug. 1990 111 p Sponsored by AFIT, Wright-Patterson AFB, OH and ONR
(AD-A224681; AFIT/CI/CIA-90-017D) Avail: NTIS HC/MF A06 CSCL 14/2

The quartz crystal microbalance (QCM) is emerging as a powerful new tool in sensor technology. In the course of this work, the QCM is used to study solvent and ion transport in poly(vinyl chloride) (PVC) ion-selective electrode (ISE) membranes and as a base for thin film analytical sensors for specific ionic species in solution. Thin (approximately 1.5 micrometer) PVC-based ISE membranes swell in solution due to solvent and/or ion uptake, the resultant mass change in the film causes the resonant frequency of the quartz crystal to decrease. The frequency measurements obtained when exposing ISE-type membranes containing neutral carrier type ionophores to analyte-containing solutions allow one to approximate the mass of solvent and analyte ions that entered the films during sensor operation. GRA

N91-12067# Michigan Univ., Ann Arbor.
MULTIPURPOSE 2000 C FURNACE FOR PHYSICAL TESTING IN CONTROLLED ATMOSPHERE Final Report, 1 Nov. 1988 - 31 Oct. 1989
I-Wei Chen 5 Feb. 1990 2 p
(Grant AF-AFOSR-0127-89; AF Proj. 3842)
(AD-A224851; USMC-89-C-AF-1; AFOSR-90-0831TR) Avail: NTIS HC/MF A01 CSCL 13/1

A high temperature (2000 C) furnace and a servohydraulic test frame were purchased and installed for physical testing in controlled atmospheres of structural ceramics made superplastic by advanced ceramic processing. GRA

N91-12068# California Univ., Los Angeles. Dept. of Chemistry and Biochemistry.
EFFECTS OF TIP-BROADENING AND ASYMMETRY ON SCANNING TUNNELING MICROSCOPE TOPOGRAPHS Technical Report No. 7, 1 Oct. 1989 - 31 May 1990
Eric J. Snyder, Elliott A. Eklund, and R. Stanley Williams 1 Jul. 1990 16 p Submitted for publication
(Contract N00014-90-J-1178)
(AD-A224883) Avail: NTIS HC/MF A03 CSCL 14/3

Investigated are broadening and skewing of scanning tunneling microscope topographs caused by tip size and symmetry. Model images were generated numerically by convoluting a Gaussian response function for the tip with an idealized graphite image. Atomic scale features were retained even for a 9.4 A FWHM tip function, which demonstrated that single atom tips are not required to obtain atomic resolution topographs. Model tips with an elliptical radial cross section produced many of the familiar skewed images of graphite. Such response functions could also be used to remove the skew from an experimental topograph, and thus provide an approximation for the shape of the physical tip. GRA

N91-12069# European Space Agency, Paris (France).
EQUIPMENT AND METHODS EMPLOYED FOR CALIBRATION OF THE SENSORS AND MEASUREMENT LINES IN THE ATTAS FLIGHT TEST PLATFORM
Rudolf Oliva and Dieter Otto (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) Aug. 1990 93 p Transl. into ENGLISH of Einrichtungen und Verfahren zum Kalibrieren von Sensoren und Messketten im Flugversuchstraeger ATTAS (Brunswick, Fed. Republic of Germany, DFVLR), Dec. 1988 94 p Original language document was announced as N90-12007
(ESA-TT-1208; DFVLR-Mitt-89-06; ETN-90-98014) Avail: NTIS HC/MF A05

A description of installations responsible for testing and calibration are presented. The fitting of the installations and the corresponding calibration methods are described. Proposals for improving calibration installations and methods are given. ESA

N91-12070# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abt. fuer Systemtechnik und Navigation.
INVESTIGATION OF THE DYNAMIC BEHAVIOR AND THE FREQUENCY RESPONSE OF THE LASER GYRO GG 1342
Helmut Niederstrasser Jan. 1990 95 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1236)
(DLR-FB-90-22; ISSN-0171-1342; ETN-90-98044) Copyright Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 33 Deutsche marks

The dynamic behavior of a laser gyro under angular vibrations and constant angular rates on a single axis test table is investigated. The frequency response was studied and the measurement rate was described by power spectral densities. The hybrid angular velocity reference system was composed of an inductosyn, a tachometer and a linear accelerometer. The measurement characteristics were discussed including the measurement noise and the disorder reaction notion. The adaptability of a laser gyro to inertial navigation and flight control is demonstrated. ESA

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N91-12071*# Oklahoma State Univ., Stillwater. Dept. of Physics.
GROWTH AND CHARACTERIZATION OF TUNABLE SOLID STATE LASERS IN THE NEAR INFRARED SPECTRAL REGION Final Report
Richard C. Powell and Joel J. Martin 30 Oct. 1990 36 p Original contains color illustrations
(Grant NAG1-694)
(NASA-CR-187380; NAS 1.26:187380) Avail: NTIS HC/MF A03; 1 functional color page CSCL 20E

This research resulted in the publication of two major papers. The major results include the development of improved crystal growth techniques for rare earth-doped LiYF4 crystals and the determination of laser-pumped laser characteristics of Tm:Ho:Y3Al5O12 crystals. Author

N91-12072 Dartmouth Coll., Hanover, NH.
A SELF-CONSISTENT ANALYSIS OF FAR-INFRARED AND SUBMILLIMETER WAVELENGTH METAL-GRATING FREE ELECTRON LASERS Ph.D. Thesis
Yansun Xu 1990 164 p
Avail: Univ. Microfilms Order No. DA9028119

A theoretical exploration of the characteristics and operational requirements of far-infrared and sub-millimeter wavelength metal-grating free-electron lasers is presented. In the device an open planar type of quasi-optical resonator is loaded with a strip of rectangular metal-grating, and driven by a moderate energy electron beam. The basic tuning features and energy storage capacity of the resonator are described by the dispersion relation of the periodic slow-wave structure. To give a complete description of electron and wave dynamics in the laser oscillator, a set of self-consistent equations are derived through the use of the Lorentz force equation and the Maxwell's equations. Small signal gain and output efficiency of the device are developed from the self-consistent model. The nonlinear saturation is examined with a strong-field technique which is based upon a simple nonlinear ordinary differential equation of Duffing type. A detailed evaluation of the start-current, optimum interaction length, and output efficiency of the laser oscillator at far-infrared and sub-millimeter wavelength region, indicates that the operations at wavelengths from 1 mm to 100 microns could be optimized at the output efficiencies around 1 percent with the use of a 100 keV to 1 MeV electron beam of current densities from 10 to 100(A/sq cm) and a 10 to 20 cm long grating section. A theory of klystron type metal-grating free electron lasers is also developed. Results of the proof-of-principle tests in the lower-millimeter wavelength region show that the klystron type devices generate more coherent radiations with start-current below 0.5A, output power and efficiency up to 600 watts, and 2 percent at about 35 GHz. Dissert. Abstr.

N91-12073# Sandia National Labs., Albuquerque, NM.
SIMPLIFIED VELOCITY INTERFEROMETER SYSTEM FOR ANY REFLECTOR (VISAR) SYSTEM
W. C. Sweatt, P. L. Stanton, and O. B. Crump, Jr. 1990 12 p Presented at the SPIE's International Symposium on Optical and Optoelectronic Applied Science and Engineering Exhibit, San Diego, CA, 8-13 Jul. 1990
(Contract DE-AC04-76DP-00789)
(DE91-000024; SAND-90-2419C; CONF-900756-43) Avail: NTIS HC/MF A03

A simplified, rugged VISAR (Velocity Interferometer System for Any Reflector) system was developed using a nonremovable delay element and an essentially nonadjustable interferometer cavity. In this system, the critical interference adjustments are performed during fabrication of the cavity, freeing the user from this task. Prototype systems are easy to use and give extremely high quality results. DOE

N91-12074# Los Alamos National Lab., NM.
THREE-DIMENSIONAL SIMULATIONS OF HARMONIC RADIATION AND HARMONIC LASING
Mark J. Schmitt and Brian D. McVey 1990 17 p Presented at the 12th International Free Electron Laser Conference, Paris, France, 17-21 Sep. 1990
(Contract W-7405-eng-36)
(DE91-000235; LA-UR-90-3138; CONF-9009166-5) Avail: NTIS HC/MF A03

Characteristics of the harmonic emission from free electron lasers (FELs) are examined in the spontaneous, coherent-spontaneous and stimulated emission regimes. The radiation at both odd and even harmonic frequencies is treated for electron beams with finite emittance and energy spread. In the spontaneous emission regime, the transverse radiation patterns including the transverse frequency dependences, are given. How this expression is modified to include energy spread and emittance is described. In the coherent-spontaneous emission and stimulated emission regimes, the interaction of the radiation fields with the electrons must be treated self consistently. Here, a single frequency distributed transverse source function for each electron is used in the harmonic version of the 3-D code FELEX to model the harmonic radiation. The code has recently been modified to simultaneously model the fundamental and harmonic interactions for multiple-pass oscillator simulations. These modifications facilitate the examination of FELs under various operating conditions. When the FEL is lasing at the fundamental, the evolution of the harmonic fields can be examined. This evolution is unique in the sense that the electron beam radiates at the harmonic frequencies in the presence of the harmonic radiation circulating in the cavity. As a result, enhancements of the harmonic emission can be observed. Finally, harmonic lasing can occur in cases where there is sufficient gain to overcome cavity losses and lasing at the fundamental can be suppressed. The characteristics and efficiency of these interactions are explored. DOE

N91-12075# Los Alamos National Lab., NM.
INTENSITY DEPENDENT THOMSON SCATTERING AND HARMONIC GENERATION FROM FREE ELECTRONS
Gottfried T. Schappert 1990 12 p Presented at the 5th International Conference on Multiphoton Processes, Paris, France, 24-28 Sep. 1990
(Contract W-7405-eng-36)
(DE91-000236; LA-UR-90-3133; CONF-900926-2) Avail: NTIS HC/MF A03

The electron motion in an intense laser field is discussed along with the radiation produced by this motion, and finally some issues involved in experiments to observe the harmonics and their frequency shifts. DOE

N91-12076# Lawrence Livermore National Lab., CA.
NOVEL PLASMA-BASED FREQUENCY UPSHIFT METHODS FOR SHORT PULSE LASERS
S. C. Wilks, J. M. Dawson, and W. B. Mori (California Univ., Los Angeles.) 4 Jun. 1990 21 p Presented at the Topical Conference on Research Trends in Nonlinear and Relativistic Effects in Plasmas, LaJolla, CA, 6-9 Feb. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE91-000411; UCRL-JC-104417; CONF-900264-8) Avail: NTIS HC/MF A03

We discuss various novel methods of frequency upshifting short (less than or equal to 1 picosecond) pulses of laser light. All of these methods make use of either the sudden creation of a plasma or relativistic plasma waves. The first method discussed is known as photon acceleration. This method makes use of the fact that a laser pulse moving in a plasma can be thought of as a packet of photons, each possessing an effective mass of m(sub gamma) = h omega(sub pe)/c squared and moving with the group velocity of the laser pulse. These photons experience a force acting on them when in the presence of a gradient in the plasma density. By using a relativistic plasma wave (i.e., a moving density gradient) traveling with the photons, the energy of the photons (thus the frequency) can be continuously increased. We then

discuss the sudden creation of a plasma in a region where there exists an electromagnetic wave. This results in a frequency shift of the wave. A similar method is the creation of an ionization front moving near the speed of light, whereby the interaction of this plasma front with an EM wave also results in a frequency upshift of the original wave. DOE

N91-12077# Institut Franco-Allemand de Recherches, Saint-Louis (France).
MULTI-COMPONENT LASER DOPPLER ANEMOMETERS WITH HIGH-FREQUENCY PULSED DIODE LASERS
D. Dopheide, H. J. Pfeifer, G. Taux, and M. Faber (Physikalisch-Technische Bundesanstalt, Brunswick, Germany, F.R.) 20 Jun. 1989 16 p Presented at International Conference on Fluid Dynamic Measurement and its Application, Beijink, China, 25-28 Oct. 1989
(ISL-CO-219/89; ETN-90-98031) Avail: NTIS HC/MF A03

A concept for the simultaneous measurement of two or three velocity components in a flow by means of Laser Doppler Anemometry (LDA) using high frequency pulsed diode lasers is described. As against the known LDA techniques using continuous wave lasers, the idea of the method is to use high frequency pulsed diode lasers with pulse durations in the nanosecond range and to operate these at high repetition rates. The method offers the advantage that in pulse operation the optical transmitting power is increased and that, owing to sequential and phase synchronized pulsing of the diode lasers on the transmitting side of multicomponent LDAs, three velocity components can be simultaneously measured in a very elegant way with only one photodetector on the receiving side; moreover, a single wavelength suffices for all three channels. Another decisive advantage of a new method for electronic signal evaluation (coherent sampling) is that coincident measurement of the velocity components requires only a single electronic signal processing for all three channels. ESA

N91-12078# Institut Franco-Allemand de Recherches, Saint-Louis (France).
THE INFLUENCE OF THE COMPARISON ACCURACY IN DUAL-COUNTER LDA SIGNAL PROCESSORS ON THE MEASURING ERROR
H. J. Pfeifer, E. Sommer, and M. Koenig 10 Jul. 1989 17 p Presented at 3rd International Conference on Laser Anemometry Advances and Applications, Swansea, Wales, 26-29 Sep. 1989
(ISL-CO-222/89; ETN-90-98032) Avail: NTIS HC/MF A03

Dual counter processors are by far the most frequently used data acquisition instruments in Laser Doppler Anemometry (LDA). All commercially available processors offer the possibility to select the comparison accuracy between the two counting results. By means of experimental findings with artificial signals and by theoretical considerations, the choice of this accuracy is shown to have no influence on the measuring results, at least if the signals are well separated from each other in time. ESA

N91-12079# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
LASER
Yu. N. Mikhaylov, A. A. Mak, A. I. Stepanov, B. G. Malinin, and L. N. Soms 11 Jun. 1990 6 p Transl. into ENGLISH of Russian Patent no. 337069 (2 Nov. 1967) p 1-2
(AD-A225393; FTD-ID(RS)T-0408-90) Avail: NTIS HC/MF A02 CSCL 09/3

There exist solid-state lasers whose working bodies have the shape of cylinders of different diameters. But when operating in the periodic mode and with intensive cooling of the surface of the active element, a thermal lens is formed in the rod, causing the outgoing radiation to increase in divergence, which can lead to malfunctioning of the active element. The purpose of the invention is to increase the allowable repetition frequency of the radiation pulses, that is, to increase the mean laser radiation power and to narrow its radiation pattern. GRA

N91-12080# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart (Germany, F.R.). Inst. fuer Technische Physik.
LASER TECHNOLOGY FOR SPACE TASKS
Uwe Brauch, Wolfgang Schall, Gerhard Spindler, Wolfram Wittwer, and Eberhard Zeyfang Apr. 1990 52 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1246)
(DLR-Mitt-90-10; ISSN-0176-7739; ETN-90-98048) Copyright Avail: NTIS HC/MF A04; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 20 Deutsche marks

The possibilities of using lasers for energy supply, transport and debris elimination in space are studied. Laser cutting has been successful for aluminum, titanium and their alloys, and ceramics and composites, for space structures. Optimal photoelectric convectors of laser light to electric energy show a high efficiency, such as thermic lasers, which seem a good alternative to chemical and electrical energy vectors for low Earth orbital stations. For the estimation of the debris size, the focusing of a laser beam with lenses or a little mirror is possible with mean power lasers. It is concluded that laser technology shows a high potential for the future and needs a better development. ESA

N91-11705*# Spectra Technology, Inc., Bellevue, WA.
THE WINDVAN PULSED CO2 DOPPLER LIDAR WIDE-AREA WIND SENSOR
Rhidian Lawrence *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 2 Jul. 1990 p 835-842 (For primary document see N91-11695 03-03)
Avail: NTIS HC/MF A20 CSCL 20E

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N91-12081# Southwest Research Inst., San Antonio, TX. Dept. of Engine and Vehicle Research.
LABORATORY EVALUATIONS OF CONTROLLED COMBUSTION QUENCHING AND STRATIFIED EXHAUST GAS INJECTION FOR NOx CONTROL ON A FOUR-STROKE RECIPROCATING ENGINE Topical Report, May 1987 - Dec. 1988
R. H. Thring Jun. 1990 66 p
(Contract GRI-5084-251-1101)
(PB90-258971; SWRI-03-1781-102; GRI-90/0069) Avail: NTIS HC/MF A04 CSCL 13I

The report describes laboratory evaluations of controlled combustion quenching (CCQ) and stratified exhaust gas injection (SEG), two newly proposed techniques for NO(x) control in natural gas piston engines. With CCQ a quenching fluid is injected into the combustion chamber during the combustion process. CCQ showed NO(x) reductions of 60 to 85 percent, with relatively small penalties in fuel consumption (less that 8 percent) and other emissions. Another potential advantage of CCQ is that, unlike conventional water injection, there seemed to be very little contamination of the lubrication oil. This fact suggests that CCQ may be applicable without causing engine durability degradation, such as has been feared for conventional water injection. Engine tests of stratified exhaust gas injection were not so promising in that, for a given flow rate of exhaust gas the stratified exhaust gas gave only half as much reduction in NO(x) as homogeneous exhaust gas recirculation. However, it is believed that the exhaust gas stratification was not optimally configured; that is, the exhaust gas cloud was located too far from the spark plug. GRA

N91-12082 Aston Univ., Birmingham (England).
FLEXIBLE HIGH-SPEED MACHINERY Ph.D. Thesis

Lee Fenney 1989 240 p
Avail: Univ. Microfilms Order No. BRDX89642

An investigation into methods for the design of flexible high-speed product processing machinery is described, consisting of independent electromechanically actuated machine functions which operate under software coordination and control. An analysis is made of the elements of traditionally designed cam-actuated, mechanically coupled machinery, so that the operational functions and principal performance limitations of the separate machine elements may be identified. These are then used to define the requirements for independent actuators machinery, with a discussion of how this type of design approach is more suited to modern manufacturing trends. A distributed machine controller topology is developed which is a hybrid of hierarchical and pipeline control. An analysis is made, with the aid of dynamic simulation modelling, which confirms the suitability of the controller for flexible machinery control. The simulations include complex models of multiple independent actuators systems, which enable product flow and failure analyses to be performed. An analysis is made of high performance brushless dc servomotors and their suitability for actuating machine motions is assessed. Procedures are developed for the selection of brushless servomotors for intermittent machine motions. An experimental rig is described which has enabled the actuation and control methods developed to be implemented. With reference to this, an evaluation is made of the suitability of the machine design method and a discussion is given of the developments which are necessary for operational independent actuators machinery to be attained. Dissert. Abstr.

N91-12083 Sheffield Univ. (England).
THEORETICAL AND EXPERIMENTAL STUDY ON THE ULTRASONIC FUEL INJECTOR VALVE Ph.D. Thesis
Hazim Muhammade Ali Al-Hussaini 1980 338 p
Avail: Univ. Microfilms Order No. BRDX88912

A theoretical and experimental investigation is described of an ultrasonic fuel injector valve constructed from a tapered metal horn whose wide end is bonded to a quartz crystal. Fuel enters sideways at the longitudinal antinode and passes along a central hole to a ball valve at the tip. When the crystal is driven by an oscillatory pulse, it excites longitudinal vibrations, bounding the ball from its seat and releasing fuel. The ball motion without any liquid resistance was studied theoretically through a computer program. Parameters such as the maximum gap between the ball and the seat, the frequency, amplitude and initial condition of the tip motion, and the time of impact were studied, and compared with measurements of ball motion in a large vibrating model. The injector tip motion was measured using a laser technique. The measurements were made with and without fuel flow. The effects of the fuel supply pressure and pulse width on the tip motion were studied. Using this data, the effect of the actual (non-ideal) motion of the tip on the behavior of the ball was studied theoretically. A model of the valve was designed so that flow forces on the ball and the flow rates through the various passages could be measured. Using this data, the ball motion with fluid resistance was computed under various conditions. This in turn permitted the fluid flow from the injector valve to be predicted. Five scale models of new valve geometries were designed and installed on an improved test rig. By this means, the effect of valve geometry on flow force and the flow rates within the valve were studied. The behavior of actual injector flow during flow pulses was studied using laser anemometry. Dissert. Abstr.

N91-12084 Purdue Univ., West Lafayette, IN.
PROBABILISTIC MODELING AND OPTIMAL DESIGN OF ROBOTIC MANIPULATORS Ph.D. Thesis
Pardeep Kumar Bhatti 1989 181 p
Avail: Univ. Microfilms Order No. DA9018787

A high performance, high speed robotic arm must be able to manipulate objects with a high degree of accuracy, repeatability and dexterity. As with any other physical system, there are a number of factors causing uncertainties in the behavior of a robotic manipulator. These factors include manufacturing and assembling tolerances, and errors in the joint actuators and controllers. In order to study the effect of these uncertainties on the robotic end-effector and to obtain a better insight into the manipulator behavior, the concepts of theory of probability are applied to the manipulator kinematics and dynamics. Based on these probabilistic models, kinematic and dynamic performance criteria are defined to provide a measure of the behavior of the robotic end-effector. Techniques are presented to compute these criteria. The effect of the tolerances on various manipulator parameters on these criteria is studied. A methodology is developed to assign the tolerances optimally, that maximizes these criteria subject to constraints on the manipulator cost. Results show that very significant and cost effective improvements can be achieved in the manipulator performance with the use of optimal tolerances. Another desirable property of a robotic arm is the degree of dexterity with which it can manipulate objects. This aspect of the manipulator performance is investigated, and new criteria are proposed to provide a measure of the kinematic, dynamic, and force manipulating abilities. It is shown that optimization of these criteria can lead to significant improvements in the overall manipulating capabilities of a robotic arm. Numerical illustrations are presented throughout this dissertation using a two-link planar manipulator and the Stanford arm. Dissert. Abstr.

N91-12085 Michigan State Univ., East Lansing.
NONLINEAR INTERACTIONS IN ROTORDYNAMICS Ph.D. Thesis
Jinsiang Shaw 1989 142 p
Avail: Univ. Microfilms Order No. DA9018745

The non-linear dynamic behavior of symmetric rotors is investigated using methods from dynamical systems and bifurcation theories. Rotordynamic instabilities and resonances caused by internal hysteresis, fluid film bearing forces, and mass unbalance are analyzed. A slender, flexible shaft made of a viscoelastic material and rotating at a constant rate about its longitudinal axis is used to study the effects of internal hysteresis and mass unbalance on rotordynamics. An unbalanced disk mounted midway between two supporting fluid film journal bearings on a rigid shaft is used to examine the effects of fluid bearing forces and mass unbalance. For the flexible shaft model, internal damping can cause an instability at a certain critical speed. The instabilities are predicted using the linearized shaft model and the post-critical behaviors are determined by applying the center manifold theory to the full non-linear equations of motion. Synchronous whirl, non-synchronous whirl, and competing-mode types of behaviors are shown possible for various ranges of the parameter values. The first vibrational mode of the shaft is then used to determine the unbalanced effect on system behavior. Special attention is paid to the interaction between the primary resonance caused by mass unbalance and the destabilizing influence of internal damping. For the second model the non-linear oscillations of a rotor supported in fluid film journal bearings are analyzed. With the introduction of periodic forcing due to rotor unbalance, the results show that the limit cycle arising from the whirl instability in the neighborhood of the threshold speed is perturbed and harmonic, subharmonic, as well as amplitude modulated responses are observed when certain resonant conditions occur. Dissert. Abstr.

N91-12086 Council for National Academic Awards (England).
SIMULATION AND DETECTION OF TRANSVERSE CRACKS IN ROTORS. Ph.D. Thesis
Roberto F. deNoronha 1989 222 p
Avail: Univ. Microfilms Order No. BRDX89765

The detection of transverse cracks in rotors of turbo-generator units through vibration monitoring is examined. A crack model was developed using three dimensional finite element (FE) simulations. Static analyses of how a vertical bending load affects the crack opening and the local flexibility were also performed. The 3D FE mesh was generated using IDEAS and the resulting model analyzed through ABAQUS. The results from the static analysis allowed the stiffness matrix of a rotor beam element with a transverse crack at the center to be calculated. An unbalance response program was modified to work with the cracked finite element and to solve the system of equations through step-by-step

integration. Different parameters were analyzed to establish the sensitivity of a rotor containing a crack whereby whirl orbits, displacement, velocity, acceleration, and the unbalance phase angle were all studied in order to determine the best graphical output for detecting the early growth of a breathing crack. Dynamic simulations were undertaken with a finite element representation of a 500 MW generator at an operating speed of 3000 rpm with cracks of 25 and 10 percent of the diameter, located near a retaining ring. Comparisons of the crack model with another available from literature show good agreement in the vertical direction, which is a reassurance for both models, and indicate a better performance of the developed model in the horizontal direction. The simulations indicate that the harmonics of the unbalance phase angle can be a useful aid, since its higher components are more sensitive to the presence of a crack, than conventional displacement components. The technique is capable of sensing the early stages of a crack with the considerable advantage of not being affected by the presence of any other fault condition such as coupling misalignment, rubbing, etc.
Dissert. Abstr.

N91-12087 Florida Univ., Gainesville.
EFFECT OF DESIGN PARAMETERS ON THE STABILITY OF MULTIMASS GEARED SYSTEMS SUPPORTED ON FLUID FILM BEARINGS AND SUBJECTED TO UNBALANCE AND TORSIONAL EXCITATION Ph.D. Thesis
Seunghoon Ro 1989 194 p
Avail: Univ. Microfilms Order No. DA9028564

Many high speed mechanical systems incorporate gearing for speed reduction. The stability of multi-rotor geared systems supported on oil film bearings, is investigated, taking into consideration the coupling between torsional and lateral dynamics. Emphasis is on the analysis of the interaction between the combined torsional and whirl instabilities. The result of simulation in this study checked the previously published empirical approach for predicting nonharmonic whirl of geared systems which results from the inertial coupling at the gear mesh. The feasibility of inducing a lateral and torsional instability to neutralize an anticipated unstable condition is investigated. The possibility of suppressing the instabilities by controlling the parameters of the oil film bearings is also considered. It is interesting to note that the coupling between the torsional and lateral oscillations can induce torsional instability due to unbalance excitation. Similarly, a torsional disturbance can induce whirl. A procedure is given to guide the designer in selecting the system parameters which insure its safe operation in critical situations where instabilities or resonances are expected. It is shown that torsional instability can be avoided by inducing a tuned whirl using an unbalance excitation in a system supported on either ball bearings or oil film bearings. Dissert. Abstr.

N91-12088 Aston Univ., Birmingham (England).
WEAR AND CORROSION OF MECHANICAL SEALS Ph.D. Thesis
Kamaljeet Singh Sagoo 1988 335 p
Avail: Univ. Microfilms Order No. BRDX89652

The feasibility of applying surface coating/treatments to seal materials, in order to provide improved seal performance is investigated. Various surface coating/treatment methods were considered; these included electroless nickel plating, ion plating, plasma nitriding, thermal spraying, and high temperature diffusion processes. The best wear resistance was conferred by the sprayed tungsten carbide/nickel/tungsten-chromium carbide deposit, produced by the high energy plasma spraying (Jet-Kote) process. In general, no correlation was found between hardness and wear resistance or surface finish and friction. Wear mechanisms observed in the investigation included adhesive transfer, oxidation, plastic deformation, ploughing, fracture, and delamination. Corrosion resistance was evaluated by Tafel extrapolation, linear polarization, and anodic potentiodynamic polarization techniques. The best corrosion performance was exhibited by an electroless nickel/titanium nitride duplex coating. The surface coating/treatments were ranked using a systematic method, which also considered other properties such as, adhesion, internal stress, and resistance to thermal cracking. The sealing behavior of surface coated/treated seals was investigated on an industrial seal testing rig. The best sealing performances were exhibited by the Jet-Kote and electroless nickel silicon carbide composite coated seals. The failure of the electroless nickel and electroless nickel/titanium nitride duplex coated seals was due to inadequate adhesion of the deposits to the substrate. Abrasion of the seal faces was the principal wear mechanism. For operation in an environment similar to the experimental system employed (acidified salt solution) the Jet-Kote deposit appears to be the best compromise.
Dissert. Abstr.

N91-12089 Council for National Academic Awards (England).
TURBINE BLADE HEAT TRANSFER COEFFICIENT DETERMINATION USING OPTICAL PYROMETRY Ph.D. Thesis
M. H. Tothill 1989 270 p
Avail: Univ. Microfilms Order No. BRDX89761

A technique was developed for measuring local heat transfer rates from the surfaces of gas turbine blades. The technique is based on the optical measurement of transient temperatures and requires no mechanical contact. It was designed to take direct measurements from turbine blades while the engine is running and so be instrumental in turbine development. A high pressure, high temperature, turbine cascade rig was designed, constructed and developed to provide bench mark data, using well tried methods employing buried thermocouples, from which the optical technique was validated. A computational method for reducing the transient data into local heat transfer coefficients based on one-dimensional heat flux theory was devised. Dissert. Abstr.

N91-12090# Argonne National Lab., IL.
CYLINDER PRESSURE ANALYSIS OF A DIESEL ENGINE USING OXYGEN-ENRICHED AIR AND EMULSIFIED FUELS
R. R. Sekar, W. W. Murr, T. J. Marcihiak, J. E. Schaus, J. N. Eustis (Department of Energy, Washington, DC.), and R. L. Cole 1990 10 p Presented at the SAE International Off-Highway and Power Plant Congress and Exposition, Milwaukee, WI, 10-13 Sep. 1990
(Contract W-31-109-eng-38)
(DE90-017660; CONF-9009113-1) Avail: NTIS HC/MF A02

Analytical studies of oxygen-enriched diesel engine combustion have indicated the various benefits as well as the need for using cheaper fuels with water addition. To verify analytical results, a series of single cylinder diesel engine tests were conducted to investigate the concepts of oxygen enriched air (OEA) for combustion with water emulsified fuels. Cylinder pressure traces were obtained for inlet oxygen levels of 21 to 35 percent and fuel emulsions with water contents of 0 to 20 percent. Data for emulsified fuels included No. 2 and No. 4 diesel fuels. The excess oxygen for the tests was supplied from compressed bottled oxygen connected to the intake manifold. The cylinder pressure data was collected with an AVL pressure transducer and a personal computer based data logging system. The crank angle was measured with an optical encoder. In each data run, 30 consecutive cycles were recorded and later averaged for analysis. The data analysis was done with a heat release analysis code written for a personal computer. The results indicate that water emulsified fuels consistently gave a slight improvement in thermal efficiency and a greater portion of the fuel energy was released in the early part of the combustion process compared with base fuels. OEA reduced the ignition delay and measurably changed the shape of the calculated heat release rate and cumulative heat release diagrams. Comparative cylinder gas temperatures, computed from measured cylinder pressures, are presented in an effort to explain changes observed in the emissions of nitrogen oxides (NO(x)), smoke, and particulate matters. The data indicates that smoke and particulate emissions decrease and NO(x) increases when intake O2 level is increased. DOE

N91-12091# Ohio State Univ., Columbus. Dept. of Electrical Engineering.
AUTOMATED HANDLING AND ASSEMBLING OF NON-RIGID OBJECTS Semiannual Report No. 1, 15 Jan. - 15 Jul. 1990

Yuan F. Zheng 15 Jul. 1990 66 p
(Contract N00014-90-J-1516)
(AD-A224585) Avail: NTIS HC/MF A04 CSCL 20/11

Strategies for automatic assembly of deformable objects are presented. A flexible beam mating with a rigid hole is taken as the target of investigation. First, the deflection behavior of a deformable beam is studied. Then the geometric and force conditions for successfull assembly of rigid parts are reviewed. Based on these conditions of assembly, strategies for assembling deformable beams are proposed. The strategies are defined by the motion trajectory of the tool which handles the beam. It is found that when the clearance between the beam and the hole is loose, the desired trajectory should be the same as the curve formed by the deformed beam. When the clearance is tight, position and orientation of the tool should be adjusted, following the involute of the deformed beam curve. Experimental results are finally given to prove that the proposed strategies are effective. GRA

N91-12092# Pennsylvania State Univ., University Park. Applied Research Lab.
FUNDAMENTAL HYDRODYNAMICS RESEARCH Quarterly Technical Progress Report, 1 Apr. - 31 Jun. 1990
S. A. Abdallah, M. L. Billet, H. L. Petrie, P. J. Morris, and S. Deutsch 30 Jun. 1990 16 p
(Contract N00014-87-K-0196)
(AD-A225030) Avail: NTIS HC/MF A03 CSCL 20/4

The hydrodynamics research conducted under this program falls into two basic areas: (1) Turbomachinery: To develop an improved understanding of the fluid mechanics and acoustics associated with low-speed turbomachines and marine propulsors. To employ this knowledge to the development of improved propulsor and turbomachine design methods. (2) Drag reduction: To develop fundamental understanding of the mechanisms that cause drag on bodies and surfaces and to explore novel methods to reduce drag. Under each thrust area, one or more projects are conducted under the direction of the principal investigator who initiated the given task. All tasks are designed to provide results that will improve the scientific understanding of various hydrodynamic phenomena associated with the operation of submerged bodies and surfaces. This report documents the technical progress realized during the first quarter of FY-90 for the projects currently approved under this program. GRA

N91-12093# Technische Univ., Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt.
MOTION EQUATIONS AND STABILITY ANALYSIS OR SHAFT OF SINGLE-BLADED AND TWO-BLADED WIND TURBINES WITH FE-MODELED TOWER [BEWEGUNGSGLEICHUNGEN UND STABILITAETSANALYSE EIN- UND ZWEIFLUEGLIGER WINDTURBINEN MIT FE-MODELLIERTEM TURM ODER -MAST]
Johannes Ackva Aug. 1989 82 p In GERMAN
(ILR-Mitt-236(1990); ETN-90-97909) Avail: NTIS HC/MF A05

Two types of wind turbines are studied: one is the rigid two bladed, whose rotor is composed of two blades, rigidly fixed at the hub, the other is the pendulum bladed, whose rotor is composed of one rigid blade with counterweight or two rigid blades. For their mechanical models, the linear periodic time variant motion equations are installed and examined as far as stability is concerned, with the Floquet Method. The Finite Element Method is used in the modeling. The results show that the rigid two bladed is less susceptible to instability than the pendulum-bladed. ESA

N91-12094# Naval Postgraduate School, Monterey, CA.
STATISTICAL APPROACH TO FAULT DETECTION OF GEARS M.S. Thesis
John D. Robinson Dec. 1989 204 p
(AD-A225386) Avail: NTIS HC/MF A10 CSCL 13/9

The cost associated with machinery maintenance is a major portion of operating expenses. Vibration analysis, used as a method of monitoring the condition of machinery, provides a means to identify machinery faults before significant levels of damage occur. The results of research using statistical parameters of the vibration signal produced by machinery is presented. The statistical parameters investigated included the mean, mean square, variance, and coefficients of skewness and kurtosis. These values are compared with results of spectrum analysis techniques similar to methods used by the United States Navy in machinery programs. The investigation focuses on the use of band limited statistical parameters used as a fault detection technique that permits machinery operation to be categorized as satisfactory or unsatisfactory. GRA

N91-12095# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
THE GRASPING PROBLEM: TOWARD TASK-LEVEL PROGRAMMING FOR AN ARTICULATED HAND M.S. Thesis
Nancy S. Pollard May 1990 96 p
(Contracts N00014-85-K-0124; N00014-86-K-0685)
(AD-A225712; AI-TR-1214) Avail: NTIS HC/MF A05 CSCL 12/9

This report presents a system for generating a stable, feasible, and reachable grasp of a polyhedral object. A set of contact points on the object is found that can result in a stable grasp; a feasible grasp is found in which the robot contacts the object at those contact points; and a path is constructed from the initial configuration of the robot to the stable, feasible final grasp configuration. The algorithm described in the report is designed for the Salisbury hand mounted on a Puma 560 arm, but a similar approach could be used to develop grasping systems for other robots. Simulations show that the system can generate a wide range of grasps in difficult situations. GRA

N91-11829# British Aerospace Dynamics Group, Bristol (England).
SLIP COEFFICIENTS FOR SHEAR JOINTS: THE EFFECTS OF DYNAMIC LOADING AND SURFACE TREATMENT
R. J. Baylis *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 117-122 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N91-12096# China Nuclear Information Centre, Beijing.
USING ACOUSTIC EMISSION TECHNIQUE TO MONITOR FRACTURES ON THE ANALOGOUS PRESSURE PIPES
Lichen Zhang (Southwest Inst. of Nuclear Reactor Engineering, Sichuan, China) Jan. 1989 11 p
(DE90-638372; CNIC-00292; SINRE-0020) Avail: NTIS (US Sales Only) HC/MF A03

By using the acoustic emission technique to monitor the fractures on analogous pressure pipes of the primary circuit which has had cracks and loading with pressure was investigated. The dynamic process, from cracking to fracturing, was recorded by the acoustic emission technique. Comparing with the conventional method, this method gives more informations, such as pre-cracking, cracking growing, fast fracturing, and the pressure values at different phases. During testing time a microcomputer was used for real-time data processing and locating the fracturing position. These data are useful for the mechanical analysis of the reactor components. DOE

N91-12097# Polytechnic Inst. of New York, Brooklyn.
IN SITU FAULT DETECTION BY THE HYBRID RAY MODE METHOD Final Report, 1 Sep. 1986 - 28 Feb. 1990
Leopold B. Felsen and J. M. Klosner 9 Jul. 1990 18 p
(Grant AF-AFOSR-0318-86; AF Proj. 2306)
(AD-A224735; AFOSR-90-0829TR) Avail: NTIS HC/MF A03 CSCL 13/6

The objective of this research effort has been to develop

algorithms for in situ location and identification, by ultrasound, of flaws in plates or laminated layered elastic materials. Achieving this objective requires detailed knowledge of the excitation, propagation, scattering and detection of high frequency sound waves in the unflawed and flawed environments. Based on an understanding of these fundamental wave phenomena, one may then attempt to construct analytical models with accompanying algorithms, so as to parametrize the nondestructive evaluation (nde) problem in terms of good observables. During the contract period, carefully selected prototype problems have been investigated to determine good observables for particular flawed environments. Two major phases have received attention: (1) phenomena within a flat layered plate, especially beam-to-mode conversion, and the consequent interaction with a weak debonding flaw; (2) characterization of transducer outputs in terms of good wave objects that facilitate coupling into and out of the plate environment. The analytical tools rely on spatial and spectral domain formulations, and they comprise self-consistent hybrid beam-mode methods; complex source modeling of Gaussian beams, with complex ray tracing to track such beams; and decomposition of general wavefields into Gaussian beams. Thus, Gaussian beams, which are good observables are central to the problem strategy. GRA

N91-12098# Rolls-Royce Ltd., Derby (England).
THE DEVELOPMENT OF SCORPIO AS A COMMERCIAL PRODUCT
I. J. Shellard, C. Baxter, and A. T. Jones 15 Jun. 1990 13 p (PNR-90746; ETN-90-97953) Copyright Avail: NTIS HC/MF A03

SCORPIO is an inspection system used in precision casting facilities to measure the orientation of the crystal axes with respect to the design axes within single crystal turbine components. The system is used in the production environment and as such operated either by production quality control personnel or totally robotically. The factors which created the need for SCORPIO and the history of its technical development, with focus on the effect that the decision to market the product commercially has had on the specification and the manner in which the project has progressed, are described. ESA

N91-11834# Aeritalia S.p.A., Pomigliano D'Arco (Italy). Transport Aircraft Group.
DETECTION OF IMPACT DAMAGE IN COMPOSITES BY HOLOGRAPHIC INTERFEROMETRY
G. Cavaccini, P. Ferraro, and C. Sabatino *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 145-149 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11835# Aeritalia S.p.A., Pomigliano D'Arco (Italy).
HOLOGRAPHIC INTERFEROMETRY AS AN INSPECTION TECHNIQUE ON AEROSPACE COMPOSITE STRUCTURE
P. Ferraro, L. Pagnotta, A. Poggialini (Calabria Univ., Arcavacta di Rende, Italy), and C. Sabatino *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 151-155 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11837# Sira Inst. Ltd., Chislehurst (England).
NDT OF CFRP STRUCTURES: EVALUATION OF A NEW METHOD
J. M. B. Webber *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 163-169 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11838# Aerospatiale Aquitaine, Saint-Medard en Jalles (France). Strategic and Space Div.
NONDESTRUCTIVE INSPECTION FOR CARBON-CARBON WITH ADAPTED COATING FOR OXIDATION
P. Plotard and C. LeFloch *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 171-179 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11839# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
INFRARED THERMOGRAPHY DEVELOPMENT FOR MATERIAL EVALUATION OF HERMES SPACE PLANE COMPONENTS
Herve Tretout, Jean-Yves Marin, and Rene DeMol *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 181-184 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11877# Bundesanstalt fuer Materialpruefung, Berlin (Germany, F.R.).
X RAY DIFFRACTION SCANNING MICROSCOPY: A NEW METHOD OF NON-DESTRUCTIVE CHARACTERIZATION OF INHOMOGENEOUS MATERIALS
M. P. Hentschel, A. Lange, and W. Harbich *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 447-450 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N91-12099 Michigan Univ., Ann Arbor.
PARAMETRIC RESONANCE OF ARBITRARILY LAYERED COMPOSITE CIRCULAR CYLINDRICAL SHELLS Ph.D. Thesis
Alan Argento 1989 170 p
Avail: Univ. Microfilms Order No. DA9013850

A composite circular cylindrical shell subjected to harmonic axial loading is studied. The shell is composed of arbitrarily layered fiber reinforced laminae. Lamination theory is used to develop the stiffness properties of the overall shell structure. Coupling between bending, stretching, and twisting in the shell's response can result because of the generality of the layering. The shell is modeled using thin shell theory. An element of the shell in a deformed configuration gives the equations of motion, one of which is nonlinear. Linearization is achieved via a perturbation technique which involves splitting the solution into a pre-instability response and a perturbed response. The equations of motion for the perturbed response of the shell are first partially uncoupled. Fourier series' are then used to suppress spatial dependence and generate a set of Mathieu-type differential equations. The static and dynamic stability, as well as the free vibration natural frequency of a response described by a set of Mathieu equations each involve the numerical calculation of a determinant. This is done by solving the associated eigenvalue problem. The unperturbed response is assumed to be axisymmetric and inertialness; the unperturbed response equations of motion are then solved. Spatial variation in these solutions is allowed, in contrast to the commonly used assumption of a constant membrane state. The effects on parametric resonance of including unperturbed response spatial dependence is studied. The variation of the parametric resonance frequency with lamina orientation is studied. Dissert. Abstr.

N91-12100 Cornell Univ., Ithaca, NY.
LOW-DIMENSIONAL, CHAOTIC, NONPLANAR MOTIONS OF THE ELASTICA: EXPERIMENT AND THEORY Ph.D. Thesis
Joseph Paul Cusumano 1990 236 p
Avail: Univ. Microfilms Order No. DA9018121

New analytical and experimental techniques from dynamical systems theory are combined with a geometrically exact rod theory to yield insight into the source of complex dynamical phenomena observed in a thin prismatic steel rod. Because of the geometry of the system, it is expected that the motions remain planar.

However, experiments show that planar motions become unstable in wedged-shaped regions of the forcing frequency, forcing amplitude parameter plane, with each wedge centered on a resonant frequency of the system. The motions inside of these wedges are observed to be nonplanar and chaotic. A family of asymmetric bending-torsion nonlinear modes are found experimentally, and the frequency/amplitude characteristic of the family is obtained. Other phenomena discovered include dynamic two-well behavior and energy cascading from high to low frequencies. The fractal dimension of the attracting sets in different resonant wedges are estimated from experimental scalar time series using a numerical code. Starting with a geometrically exact, linearly elastic rod theory, a model system of two nonlinearly coupled partial differential equations is derived. The dynamics of a two-mode model incorporating a single bending and a single torsional mode are explored, and a simple mechanical analogue is described. Nonlinear modes analogous to those found experimentally in the rod are discovered numerically in the two-mode model. Numerically obtained Poincare sections for a related Hamiltonian system reveal that the nonlinear modes are born by a pitchfork bifurcation in the energy. Dissert. Abstr.

N91-12101 Illinois Univ., Chicago.
ON THE FOUNDATIONS OF BEAM THEORY Ph.D. Thesis
Hui Fan 1989 94 p
Avail: Univ. Microfilms Order No. DA9015746

The asymptotic parameter expansion technique is employed to carry out a rigorous examination of existing formulations for the elastic response of beam type bodies. Advantages are that no prior assumptions regarding stress and displacement variations are needed and that the interior and boundary layer problems are defined in a consistent way. Both the outer expansion which is valid in the interior of the beam, and the inner expansion valid in the end zones, are developed. The boundary conditions for the outer expansion are constructed with the aid of auxiliary solutions which are canonical and without analytical form in general. Although the asymptotic approach has proved to be of great value in the theoretical analysis of elastic bodies and in developing some benchmark solutions, the resulting formulations have previously not been used as a basis for engineering beam theories. An engineering beam theory is derived based on the asymptotic outer expansion. Comparisons between the present theory and other engineering beam theories, such as the Timoshenko theory, are carried out through numerical analysis. Dissert. Abstr.

N91-12102 Cornell Univ., Ithaca, NY.
TRANSIENT STRESS WAVES IN TRUSSES AND FRAMES Ph.D. Thesis
Samuel Moss Howard 1990 170 p
Avail: Univ. Microfilms Order No. DA9018143

The dynamics of lattice-type structures in the form of planar trusses and frames are investigated in terms of axial and flexural waves which propagate along members and scatter at structural joints. Theoretical and experimental results are presented for pin-jointed trusses and frames with rigid joints. The axial waves are considered along first, whose reflection and transmission at joints are related by analytical scattering coefficients. The complex reverberations of waves within a structure are calculated in the frequency domain with a technique called the reverberation method, which is implemented on a digital computer. Transient waves are then computed by Fourier synthesis. Results of extensive laboratory experiments are also presented. Techniques were developed for the generation and measurement of broadband stress waves in truss structures, using foil strain gages, and an elaborate digital data processing system. The results of these experiments are compared to theoretical simulations based on the axial wave theory. A general theory including both axial and flexural waves is developed, where the latter are predicted with either the Euler-Bernoulli or Timoshenko theories of bending, which introduce two modes of flexural waves in each member. First, general scattering coefficients for all three modes of waves at a joint are derived, and are shown to agree closely with experiments done on a single joint. The reverberation method is then generalized to include these general scattering coefficients, with the simplification that the mode conversion from flexural waves to axial waves at each joint is negligible. Simulated axial waves based on this assumption are found to be in much better agreement with the aforementioned experimental data over a longer duration of observation. Dissert. Abstr.

N91-12103 Bristol Univ. (England).
NONLINEAR ANALYSIS AND TESTING OF ADHESIVE JOINTS UNDER IMPACT AND QUASI-STATIC LOADING Ph.D. Thesis
J. A. Harris 1983 276 p
Avail: Univ. Microfilms Order No. BRDX88646

The current standard test method for determining the impact performance of adhesives was assessed, both theoretically and experimentally. The shortcomings of the test are shown to limit the usefulness of the results. An impact test was devised based on the single lap joint, to enable a clearer understanding of the impact performance of adhesive joints to be gained. Although joint strength was found to be insensitive to loading rate, the mechanical properties of the adhesives were shown to be very dependent on rate. Tests were carried out on bulk specimens over a range of quasi-static and impact rates for both pure shear and uniaxial tensile loading. An analysis of the single lap joint was carried out using a large displacement finite element method. By including the elasto-plastic properties of the adhesives and adherends into the finite element analysis, stress and strain distributions were determined in the various joints over a range of applied load. From these, together with appropriate failure criteria based on the uniaxial tensile properties of the adhesives, reasonable predictions of the locus of failure as well as joint strength were made.
Dissert. Abstr.

N91-12104*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
STRENGTH SCALING IN FIBER COMPOSITES Final Report
Sotiris Kellas and John Morton Washington NASA Nov. 1990 80 p
(Contract NAS1-18471)
(NASA-CR-4335; NAS 1.26:4335) Avail: NTIS HC/MF A05 CSCL 20K

A research program was initiated to study and isolate the factors responsible for scale effects in the tensile strength of graphite/epoxy composite laminates. Four layups were chosen with appropriate stacking sequences so as to highlight individual and interacting failure modes. Four scale sizes were selected for investigation including full scale size, 3/4, 2/4, and 1/4, with n = to 4, 3, 2, and 1, respectively. The full scale specimen sizes was 32 piles thick as compared to 24, 16, and 8 piles for the 3/4, 2/4, and 1/4 specimen sizes respectively. Results were obtained in the form of tensile strength, stress-strain curves and damage development. Problems associated with strength degradation with increasing specimen sizes are isolated and discussed. Inconsistencies associated with strain measurements were also identified. Enhanced x ray radiography was employed for damage evaluation, following step loading. It was shown that fiber dominated layups were less sensitive to scaling effects compared to the matrix dominated layups. Author

N91-12105 Kentucky Univ., Lexington.
NONLINEAR THERMOELASTIC ANALYSIS OF LAMINATED PLATES AND SHELLS Ph.D. Thesis
Nan-Nong Huang 1990 319 p
Avail: Univ. Microfilms Order No. DA9023339

The use of anisotropic composites in applications involving severe thermal environments has increased dramatically in recent years. Geometrically nonlinear static and dynamic thermoelastic problems of laminated plates, cylindrical panels and shallow doubly-curved shells are the subject of the present investigation. The geometric nonlinearity considered here is that implied by the von Karman theory. Plate and shell behaviors are investigated using the first-order shear deformation theory (FSDT). The Love first geometric assumption is employed to simplify the shell formulations. First, the limitations of using the FSDT and Love's

first approximation in predicting the responses of laminated shells to both mechanical and thermal loadings are examined. Results based on the shell theory are compared with the corresponding three-dimensional elasticity solutions. The quasi-static, large-deflection behaviors of laminated panels subject to a uniform temperature rise are analyzed using the finite element method. The structural behaviors of shallow panels are seen to be characterized by the existence of instabilities (bifurcation and snapping). Tracing the post-bifurcation and post-limit equilibrium paths represents an essential part of the nonlinear analysis. Some of the laminates considered undergo two instabilities prior to stress failure. Effects of the stacking sequence and shell geometries upon the critical and failure temperatures of the laminates are investigated. Nonlinear thermally-induced vibrations of laminated panels subject to rapid heating are also examined. The finite element technique is employed to discretize the space domain, and the resulting nonlinear differential equations are solved numerically by the Newmark method. The role of inertia is seen to be important in cases of shallow and thin laminates.

Dissert. Abstr.

N91-12106 Cornell Univ., Ithaca, NY.
TIME DEPENDENCE OF THE DISPLACEMENT FIELDS AROUND FIBER BREAKS IN A COMPOSITE WITH A POWER-LAW CREEPING MATRIX Ph.D. Thesis
Deborah Dawn Mason 1990 213 p
Avail: Univ. Microfilms Order No. DA9027107

A shear-lag formulation is presented which investigates the character of the stress redistributions in the vicinity of single fiber failures in simple, tape-like composites. These composites are composed of small numbers of parallel, linearly elastic fibers embedded in a matrix lamina. The matrix material, in shear, creeps according to a nonlinear, power law constitutive model, which has exponents for both time and shear stress, and a simple memory of the shear stress history. Under remotely applied tensile loads, the center fiber in the symmetric model composite fails, and the load it carried is taken up in some manner by the remaining intact fibers, at least in the neighborhood of the break. The matrix transfers loads from one fiber to the next via shear tractions, so that at some distance from the fiber failure, the broken fiber is fully reloaded and the overloads in the intact fibers are eliminated. The character, physical length, and time dependence of this stress redistribution are governed by the constitutive behavior of the matrix material. An equivalent compression problem is devised, whose governing equations are transformed into self-similar form and solved. The tension problem solutions are recovered from the compression problem results. The self-similar character of these solutions is a consequence matrix constitutive behavior, however, the exponents for the self-similar growth of the deformation zone, in both time and composite stress, are different from those of the matrix constitutive law. The time dependent overload region lengths, matrix shear stresses, fiber displacements, fiber loads, and fiber strain distributions for several values of the matrix creep exponents are presented. Also included are approximations for these quantities under limiting cases of the creep exponents, which approach rigid-perfectly plastic matrix behavior. Dissert. Abstr.

N91-12107 North Carolina State Univ., Raleigh.
A BOUNDARY ELEMENT METHOD (BEM) SOLUTION FOR A FRACTIONAL OPERATOR MODELED VISCOELASTIC-ACOUSTIC SYSTEM Ph.D. Thesis
Ke-jun Xie 1990 159 p
Avail: Univ. Microfilms Order No. DA9023419

A numerical solution procedure is developed using the boundary element method (BEM) to predict the steady-state and the transient responses of a coupled arbitrarily shaped three-dimensional viscoelastic structure-acoustic cavity system. As a special application, the procedure is applied to investigate a plugged ear-canal system under external excitations. A newly explored method, the fractional operator constitutive equation, is chosen to model the mechanical behavior of the viscoelastic structure. The fractional operator model is shown to provide an accurate analytical representation of the actual viscoelastic material used in this research. A Laplace transformed viscoelastic BEM formulation, incorporating the fractional operator constitutive equation, is developed and coupled with a Laplace transformed BEM formulation for the acoustic cavity to formulate the complete numerical solution procedure. The use of the Laplace transformation facilitates the development by removing the time dependence of the system. A boundary discretization scheme using a constant triangular element is employed in the development. The transient response of the system is obtained by numerical inversion of the solution in the Laplace transformed domain. The steady-state response is obtained from the transformed solution by letting delta = i x omega in the formulation where delta is the transform parameter, i = sq root of -1, and omega is a frequency of interest. The BEM numerical procedure is implemented into a computer program. The results from the use of this computer program on several case studies are presented. Dissert. Abstr.

N91-12108 Cornell Univ., Ithaca, NY.
VIBRATION SUPPRESSION OF FLEXIBLE STRUCTURES USING COLOCATED VELOCITY FEEDBACK AND NONLOCAL ACTUATOR CONTROL Ph.D. Thesis
Pei-Yen Chen 1990 222 p
Avail: Univ. Microfilms Order No. DA9027039

A generalized colocated velocity feedback control system is proposed as an active damper which never pumps energy into the structure, and is applied to suppress the vibration in large flexible structures. Some fundamental characteristics of this system are exploited, as well as locations of poles and zeros for the open loop, and root loci for the closed loop. By minimizing a quadratic objective function defined by structural states and control forces, a suitable optimization procedure is presented to determine the optimal feedback gains in the form of general, symmetric, diagonal, and proportional matrices where the robustness property is preserved. A 6.5 m long experimental space truss with rigid joints was manufactured to implement the concept of generalized colocated velocity feedback control. The self-equilibrated internal control forces are generated through a new magnetic actuators with a high force-to-mass ratio. The corresponding velocity signals are picked up by magnetic sensors which were designed as an integral part of the actuators. In order to transmit these nonlocal torque-free control forces, an actuator mechanism was also invented. All of the results from theoretical analysis, numerical simulation, and experimental testing demonstrate that the transient vibration of the lowest modes in the experimental truss can be suppressed efficiently by using this control strategy with an optimal feedback gain. A comparison of the performance between colocated and noncolocated controls is examined. In addition, the effects on the robustness of this system due to non-ideal conditions are investigated, such as dynamic characteristics of control elements, unmodelled masses, nonlinear buckling behavior of structural members, and saturation limits on control forces.

Dissert. Abstr.

N91-12109 Vanderbilt Univ., Nashville, TN.
ANALYSIS OF CYCLIC CRACK GROWTH UNDER ROLLING CONTACT LOADING CONDITIONS Ph.D. Thesis
Pedro Cesar Bastias 1990 200 p
Avail: Univ. Microfilms Order No. DA9026461

A versatile finite element model is introduced which makes it possible to study subsurface, frictional Mode II cracks subjected to rolling contact loading, under general conditions of plane strain. The model may address the linear-elastic or linear-elastic-kinematic-plastic material behaviors. The influence of system geometry and type of loading on the crack driving force is also evaluated. The results of the finite element model are compared with analytical solutions for the non-zero crack face friction coefficient, and for an elastic material confirm the soundness of the model. In agreement with experimental results, the model predicts a faster propagation rate from the trailing tip. The increase in crack tip driving force due to the onset of cyclic plasticity is found to be easily related to material constants. The crack tip driving force, delta K(sub II), obtained by using the finite element model, agrees with well known analytical solutions for the

frictionless case. A general relationship between the crack tip driving force and the crack tip shear displacement is proven to exist, for the linear elastic material, with a non-frictional crack. Cyclic crack propagation experiments under cyclic torque plus alternating compression are described. An alternative experimental method to determine the crack propagation rate under nominal Mode III conditions is introduced. The experimentally observed reduction in the propagation rate are qualitatively explained. The morphology of the resulting fracture surface is described, as well as its influence on the propagation rate. A new technique aimed to find an effective crack face friction coefficient is presented. The complex behavior of a Mode III shear crack under compression is qualitatively described. Dissert. Abstr.

N91-12110 Cornell Univ., Ithaca, NY.
A DAMAGE INTEGRAL APPROACH FOR LOW-CYCLE ISOTHERMAL AND THERMAL FATIGUE Ph.D. Thesis
Ravichandran Subrahmanyan 1990 325 p
Avail: Univ. Microfilms Order No. DA9027105

A damage integral approach for low-cycle isothermal and thermal fatigue is examined. This approach involves the calculation of the stress, estimation of damage rates, and integration of the damage to determine the low-cycle fatigue life. The stress profile is dependent on the time profile of the applied displacement, the effective stiffness, and the inelastic deformation properties. The rate of damage accumulation is influenced by the stress state, the environment, and the temperature. A phenomenological approach based on a state variable concept was adequate in describing the stresses for a variety of test methods and loading profiles. The considerations involved in the application of a similar approach to damage rate modelling is considered. The ramifications of the environment and damage mechanisms on a phenomenological damage rate relation are examined. The application of a damage integral approach to low-cycle high-temperature fatigue is demonstrated using solder joint fatigue. Solder joints with eutectic compositions are emphasized. First, the application of published data is reviewed and it is shown that phenomenological constitutive relations may be used to accurately calculate the stresses in the solders and solder joints during isothermal mechanical displacement and thermal displacement cycling. The determination of the crack growth is used to describe the damage rate. The effects of temperature and applied loading frequency on the crack growth rate are discussed. Finally, the considerations involved in the integration of the crack growth rate formulation, and effects of the failure criterion on the apparent fatigue life are described. Dissert. Abstr.

N91-12111 Purdue Univ., West Lafayette, IN.
PARALLEL COMPUTATIONAL METHODS ON STRUCTURAL MECHANICS ANALYSIS Ph.D. Thesis
Lung-Siaen Chien 1989 154 p
Avail: Univ. Microfilms Order No. DA9018804

A number of parallel computational methods are developed in the present study to solve structural mechanics problems. A parallel Gaussian elimination solution scheme is first introduced to solve a large system of linear algebraic equations. Then, parallelization of the non-linear finite element solution procedures is achieved by incorporating the above parallel Gaussian elimination technique. A two-dimensional large truss structure with both material and geometric nonlinearities is analyzed to demonstrate the speedup of a solution by two parallel stages, i.e., the repeated forming of the nonlinear global stiffness matrix and the solving of the global system of equations. Parallel algorithms are also developed by introducing orthogonal functions to solve two-dimensional boundary value problems. The problems governed by second order and by fourth order differential equations with regular geometrical domains are discussed. Finally, the inherent parallelism of the boundary element method is shown. The boundary element is simulated by assuming the linear variation of displacements and tractions within a straight line element. Moreover, MACSYMA symbolic program is employed to obtain the analytical results for influence coefficients. The linear speedups and high efficiencies are shown in each proposed parallel processing technique and parallel numerical algorithm for solving demonstrated problems on Sequent Balance 21000 and Symmetry S81 parallel computing systems. Dissert. Abstr.

N91-12112 Maryland Univ., College Park.
AN ASSUMED STRAIN FINITE ELEMENT MODEL FOR COMPOSITE SHELLS UNDERGOING LARGE DEFLECTION Ph.D. Thesis
Chan Hong Yeom 1989 179 p
Avail: Univ. Microfilms Order No. DA9021607

A kinematically stable nine-node mixed finite element was developed for analyses of plates and shells. The present element is based on the Hellinger-Reissner principle with independent strain and uses the degenerated solid shell concept. A new method of assuming independent strain fields was examined for a nine-node degenerated solid shell element. The independent strain is assumed initially for the local orthogonal coordinate system determined at the origin of the parent coordinates. With the strain transformation rule, the assumed strain components are transformed into the local coordinate system defined at each integration point. Then the resulting stiffness matrix is invariant even for the nonsymmetric set of polynomial terms of assumed strain. Numerical results of simple stress state problems indicate that this element is not sensitive to element distortion in flat or curved geometries. This element performs well without showing any locking tendency and all kinematic modes are properly suppressed. The linear nine-node assumed strain element was extended to non-linear analyses of isotropic and laminated composite shells undergoing large deflection with finite rotations. Displacement-dependent strain, independent strain and the determinant of Jacobian matrix are assumed to vary linearly through thickness. This allows analytical integration in the thickness direction regardless of the number of ply layups in composite structures. The present formulation also allows the reference plane to be located anywhere in the thickness direction. This feature provides a convenient means to model a shell with an internal delamination or a shell with stiffeners. The results of numerical tests indicate that the present formulation provides reliable solutions for geometrically nonlinear, isotropic, and composite plates and shells. Dissert. Abstr.

N91-12113 Wisconsin Univ., Madison.
NONLINEAR TRANSIENT FINITE ELEMENT SOLUTIONS OF VISCOELASTIC-VISCOPLASTIC PROBLEMS Ph.D. Thesis
Kevin Kuang Zhao 1989 151 p
Avail: Univ. Microfilms Order No. DA9020475

The recent development of viscous material models are summarized and a representative family of three dimensional viscoelastic-viscoplastic material models proposed which includes the widely used viscoplastic and viscoelastic models as special cases. The models also facilitate the inclusion of a variety of internal variables proposed recently by other researchers. A modified Euler algorithm is used to integrate the constitutive equations. An implicit-explicit predictor corrector scheme is used to solve the transient equations. Derivation of stability conditions for the viscoelastic part is illustrated using the central difference method. The development of the general purpose nonlinear program is discussed. The use of supercomputing also is discussed, although the material behavior of the models is the main focus. Numerical examples for one dimensional and plane strain models are presented with a variety of loadings. Dissert. Abstr.

N91-12114*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PROBABILISTIC STRUCTURAL ANALYSIS OF A TRUSS TYPICAL FOR SPACE STATION
Shantaram S. Pai Sep. 1990 11 p Presented at the 3rd Air Force/NASA Symposium on Recent Advances in Multidisciplinary Analysis and Optimization, San Francisco, CA, 24-26 Sep. 1990 (NASA-TM-103277; E-5725; NAS 1.15:103277) Avail: NTIS HC/MF A03 CSCL 20K

A three-bay, space, cantilever truss is probabilistically evaluated using the computer code NESSUS (Numerical Evaluation of

Stochastic Structures Under Stress) to identify and quantify the uncertainties and respective sensitivities associated with corresponding uncertainties in the primitive variables (structural, material, and loads parameters) that defines the truss. The distribution of each of these primitive variables is described in terms of one of several available distributions such as the Weibull, exponential, normal, log-normal, etc. The cumulative distribution function (CDF's) for the response functions considered and sensitivities associated with the primitive variables for given response are investigated. These sensitivities help in determining the dominating primitive variables for that response. Author

N91-12115*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THERMAL-STRUCTURAL FINITE ELEMENT ANALYSIS USING LINEAR FLUX FORMULATION
Ajay K. Pandey (Planning Research Corp., Hampton, VA.), Pramote Dechaumphai, and Allan R. Wieting Oct. 1990 12 p Presented at the 30th Structures, Structural Dynamics and Materials Conference, Mobile, AL, 3-5 Apr. 1989 Previously announced in IAA as A89-30711
(NASA-TM-102746; NAS 1.15:102746) Avail: NTIS HC/MF A03 CSCL 20K

A linear flux approach is developed for a finite element thermal-structural analysis of steady state thermal and structural problems. The element fluxes are assumed to vary linearly in the same form as the element unknown variables, and the finite element matrices are evaluated in closed form. Since numerical integration is avoided, significant computational time saving is achieved. Solution accuracy and computational speed improvements are demonstrated by solving several two and three dimensional thermal-structural examples. Author

N91-12116*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ZIP3D: AN ELASTIC AND ELASTIC-PLASTIC FINITE-ELEMENT ANALYSIS PROGRAM FOR CRACKED BODIES
K. N. Shivakumar (Analytical Services and Materials, Inc., Hampton, VA.) and J. C. Newman, Jr. Nov. 1990 102 p
(NASA-TM-102753; NAS 1.15:102753) Avail: NTIS HC/MF A06 CSCL 20K

ZIP3D is an elastic and an elastic-plastic finite element program to analyze cracks in three dimensional solids. The program may also be used to analyze uncracked bodies or multi-body problems involving contacting surfaces. For crack problems, the program has several unique features including the calculation of mixed-mode strain energy release rates using the three dimensional virtual crack closure technique, the calculation of the J integral using the equivalent domain integral method, the capability to extend the crack front under monotonic or cyclic loading, and the capability to close or open the crack surfaces during cyclic loading. The theories behind the various aspects of the program are explained briefly. Line-by-line data preparation is presented. Input data and results for an elastic analysis of a surface crack in a plate and for an elastic-plastic analysis of a single-edge-crack-tension specimen are also presented. Author

N91-12117*# California Univ., Santa Barbara.
MATERIALS WITH PERIODIC INTERNAL STRUCTURE: COMPUTATION BASED ON HOMOGENIZATION AND COMPARISON WITH EXPERIMENT Final Report
S. Jansson, F. A. Leckie, E. T. Onat, and M. P. Ranaweera Oct. 1990 70 p
(Grant NAG3-894)
(NASA-CR-185303; NAS 1.26:185303) Avail: NTIS HC/MF A04 CSCL 20K

The combination of thermal and mechanical loading expected in practice means that constitutive equations of metal matrix composites must be developed which deal with time-independent and time-dependent irreversible deformation. Also, the internal state of composites is extremely complicated which underlines the need to formulate macroscopic constitutive equations with a limited number of state variables which represent the internal state at the micro level. One available method for calculating the macro properties of composites in terms of the distribution and properties of the constituent materials is the method of homogenization whose formulation is based on the periodicity of the substructure of the composite. A homogenization procedure was developed which lends itself to the use of the finite element procedure. The efficiency of these procedures, to determine the macroscopic properties of a composite system from its constituent properties, was demonstrated utilizing an aluminum plate perforated by directionally oriented slits. The selection of this problem is based on the fact that, extensive experimental results exist, the macroscopic response is highly anisotropic, and that the slits provide very high stress gradients which severely test the effectiveness of the computational procedures. Furthermore, both elastic and plastic properties were investigated so that the application to practical systems with inelastic deformation should be able to proceed without difficulty. The effectiveness of the procedures was rigorously checked against experimental results and with the predictions of approximate calculations. Using the computational results it is illustrated how macroscopic constitutive equations can be expressed in forms of the elastic and limit load behavior.
Author

N91-12118 Lehigh Univ., Bethlehem, PA.
NONEQUILIBRIUM THERMAL/MECHANICAL INTERACTION OF UNIAXIAL SPECIMEN WITH ENVIRONMENT AT DIFFERENT TEMPERATURES Ph.D. Thesis
Di-Ming Chou 1990 235 p
Avail: Univ. Microfilms Order No. DA9016619

The influence of a thermal field on the stretching of a uniaxial cylindrical bar specimen made of 6061 aluminum is investigated. Prescribed is a displacement rate of 1.27 x 10(exp -4) cm per sec while the temperature sufficiently far away is maintained constant. A two-phase solid/fluid problem is solved by application of the isoenergy density theory such that the thermal/mechanical interphase conditions are determined rather than assumed as boundary of interface conditions in classical field theory. The change in local strain rates and strain rate history for each solid and fluid mass element are determined in accordance with the prescribed load or displacement rate. Thermal disturbances created by the slow stretched solid prevailed for a distance more than half the specimen length before they died out. The cooling/heating was very pronounced; temperature within the solid remained below ambient for more than 10 minutes. Thermal conductance coefficients varied with space and time, a characteristic of nonequilibrium. The classical handbook value of thermoconductivity for the 6061 aluminum corresponds closely to that obtained by averaging over all mass elements for a period of 12 minutes. They all increase slightly with rising ambient temperature. The same applied to the convective coefficient of heat transfer. Even at the very low displacement rate, the thermal/mechanical states in the described specimen were found to be highly nonequilibrium for a significant portion of the load history. The local stress, strain, temperature and energy density vary from one part of the system to another at each time instance. The conventional assumption that the state of affairs remains constant over a certain gage length cannot be justified. Nonequilibrium thermal/mechanical physical parameters can be averaged for all mass elements over a sufficiently long time to determine the constitutive coefficients for thermomechanical equilibrium field theories. Dissert. Abstr.

N91-12119 Maryland Univ., College Park.
A THREE-DIMENSIONAL ASSUMED STRESS HYBRID ELEMENT FORMULATION FOR FINITE STRAIN VISCOPLASTIC DEFORM ATION Ph.D. Thesis
Chang Sup Choi 1990 217 p
Avail: Univ. Microfilms Order No. DA9030878

A hybrid finite element formulation using both the assumed stress field and the assumed displacement field was developed for the analysis of three dimensional solids undergoing finite strain elastic-viscoplastic deformation. The eight-node three dimensional solid element is used in conjunction with a properly chosen assumed stress field. The stress field is defined in terms of local

coordinates pertaining to each element and the assumed stress parameters are eliminated at the element level. In order to maintain element invariance, an iterative method is proposed that uniquely determines the local orthogonal coordinate system for a given arbitrary geometry of an element. The incremental constitutive relation for finite strain elastic viscoplastic deformation is derived for use in the finite element formulation. The von Mises yield function with an isotropic hardening rule is assumed to define the viscoplastic strain rate. The temperature rise due to mechanical work by viscoplastic deformation is considered. For description of the geometry and the kinematics of deformation, the updated Lagrangian formulation is adopted. For timewise integration, an implicit scheme is used. The resulting system of nonlinear equations is solved using the Newton-Raphson iteration scheme. According to the numerical results, the present formulation gives the kinematically stable solution for elastic-viscoplastic as well as elastic-plastic large strain problems without showing incompressibility locking. Even though numerical tests are concentrated on two dimensional problems, the present finite element formulation can handle three dimensional problems.
Dissert. Abstr.

N91-12120 Wichita State Univ., KS.
STRUCTURAL DYNAMICS OF PLATES AND SHELLS SUBJECTED TO ELECTRO-IMPULSE DE-ICING FORCES Ph.D. Thesis
Peter Hilton Gien 1989 153 p
Avail: Univ. Microfilms Order No. DA9027479

The structural dynamics of a circular plate and a semicircular cylindrical shell with pinned boundary conditions subjected to electro-impulse deicing forces are investigated experimentally and analytically. A closed form modal synthesis method, a direct linear transient dynamics finite element method, and a non-linear direct transient dynamics finite element method are used to predict acceleration and displacement time histories on the circular plate and compared to experimental values obtained with accelerometers and optical displacement tracing devices. The presence of spurious bending waves induced by changes in finite element size was demonstrated. The comparison of experimental to predicted response revealed that geometric non-linearities accounted for large discrepancies between experimental data and linear analysis data. The effects and radial forces of transverse shear flexibility and air inertia effects were also studied. They were found to be of secondary importance. The sensitivity of the electro-impulse deicing pressure time history to electrical and geometric parameters was investigated and a least squares method of estimating circuit capacitance, lead cable inductance and resistance is presented. The computed impulse strengths were verified by a carefully controlled ballistic pendulum experiment with excellent results. A linear transient dynamic solution of the semicircular cylindrical shell compared favorably with the experimental data for large times and large distances from the applied forces. Computer animations of the acceleration and displacement time histories were prepared. Dissert. Abstr.

N91-12121 Florida Atlantic Univ., Boca Raton.
WEIGHT FUNCTION APPROACH FOR STRESS ANALYSIS OF THE SURFACE CRACK IN A FINITE PLATE SUBJECTED TO NONUNIFORM STRESS FIELDS Ph.D. Thesis
Jayant Shivkumar Jani 1990 189 p
Avail: Univ. Microfilms Order No. DA9029103

The effects of various nonuniform stress fields on the stress intensity factors for the semi-elliptic surface crack (three-dimensional problem) in a finite plate are determined using the weight function approach. The formulation satisfies the linear elastic fracture mechanics criteria and the principle of conservation of energy. Based on the knowledge of stress intensity solutions for the reference load/stress system, the expression for the crack opening displacement function for the surface crack is derived. Using the crack opening displacement function and the reference stress intensity factor, the three-dimensional weight functions and subsequently the stress intensity solutions for the surface crack subjected to nonuniform stress fields are derived. The formulation is then applied to determine the effects of linear, quadratic, cubic, and pure bending stress fields on the stress intensity factor for the surface crack in a finite plate. In the initial stage of the study a two-dimensional problem of an edge-crack emanating from the weld-toe in a T-joint is considered. The effect of parameters such as plate thickness, weld-toe radius, and weld-flank angle on the stress intensity factor for an edge-crack is studied. Finite element analyses of the welded T-joints are performed to study the effects of plate thickness, weld-toe radius, and the weld-flank angle on the local stress distribution. The ratio of plate thickness to weld-toe radius ranging from 13.09 to 153.93, and the weld-flank angles of 30, 45, and 60 degrees are considered in the analyses. Based on the results from finite element modeling (FEM) analyses, a parametric equation for the local stress concentration factor and a polynomial expression for the local stress distribution across the plate thickness are derived using the method of least squares and the polynomial curve-fitting technique. Dissert. Abstr.

N91-12122 California Univ., Berkeley.
THE INFLUENCE OF STRESS ON THE DYNAMIC RESPONSE OF ELASTIC LAYERS Ph.D. Thesis
Shih-Emn Chen 1989 106 p
Avail: Univ. Microfilms Order No. DA9028780

The influence of stress on straight-crested waves propagating in an elastic layer, either free, submerged in a fluid, or attached to a substrate is presented. The analytical solution derived from three-dimensional theory is numerically evaluated and then presented as either frequency spectra or dispersion curves. Both Lamb waves, in which the material particles move in the plane of propagation, and shear waves, in which the material particles move perpendicular to the plane of propagation, are considered to exist independently in the stressed layer. For Lamb waves the numerical data of wave propagation in a free aluminum layer, a water-loaded aluminum layer and an aluminum layer on either beryllium or fused silica are presented. For shear waves the numerical data of the aluminum layer on either beryllium or fused silica are shown as dispersion curves. At short wavelength limits of the dispersion curves the acoustoelasticities of shear and Rayleigh waves for the bulk aluminum are observed. The results of membrane theory are also obtained from the current theory in the long wavelength limit. The third-order elastic constants of the layer material are found to play an important role in the influence of stress on the wave propagation for most modes. The influence on the attenuation (corresponding to the imaginary part of wavenumber) of waves propagating in the fluid-coupled layer is also examined. The analytical results show that the solution of the fluid-coupled layer, given by the vanishing of the determinant of a 3 x 3 matrix and the solution of the layer on a substrate given by the vanishing of the determinant of a 6 x 6 matrix are much more complex than that of the free layer. However, the similarities of the influence of stress are found to exist among all of the cases. Dissert. Abstr.

N91-12123# Los Alamos National Lab., NM.
IMPLEMENTATION AND ASSESSMENT OF THE MECHANICAL-THRESHOLD-STRESS MODEL USING THE EPIC2 AND PINON COMPUTER CODES
P. J. Maudlin, R. F. Davidson, and R. J. Henninger Sep. 1990 62 p
(Contract W-7405-eng-36)
(DE90-017855; LA-11895-MS) Avail: NTIS HC/MF A04

A flow stress constitutive model based on dislocation mechanics was implemented in the EPIC2 and PINON continuum mechanics modes. This model provides a better understanding of the plastic deformation process for ductile materials by using an internal state variable called the mechanical threshold stress. This kinematic quantity tracks the evolution of the material's microstructure along some arbitrary strain, strain rate, and temperature dependent path using a differential form that balances dislocation generation and recovery processes. Given a value for the mechanical threshold stress, the flow stress is determined using either a thermal activation controlled or a drag-controlled kinetics relationship. The performance was evaluated of the Mechanical Threshold Stress (MTS) model in terms of accuracy

and computational resources through a series of assessment problems chosen to exercise the model over a large range of strain rates and strains. Our calculations indicate that the more complicated MTS model is reasonable in terms of computational resources when compared with other models in common hydrocode use. In terms of accuracy, these simulations show that the MTS model is superior for problems containing mostly normal strain with shear strains less than 0.2 but perhaps not as accurate for problems that contain large amounts of shear strain. DOE

N91-12124# Army Armament Research, Development and Engineering Center, Watervliet, NY. Close Combat Armaments Center.

THE EFFECT OF MANGANESE PHOSPHATE COATINGS ON FATIGUE CRACK INITIATION Final Technical Report

Richard Farrara and John H. Underwood Jun. 1990 29 p Sponsored by Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ

(AD-A224931; ARCCB-TR-90018) Avail: NTIS HC/MF A03 CSCL 20/11

The effect of a manganese phosphate coating on the fatigue crack initiation life of ASTM A723 high strength steel was determined. The phosphate coating process creates pitting (stress concentrators) on the surface that cause a dramatic reduction in crack initiation life. This deleterious effect on fatigue life increases as the applied stress level decreases. GRA

N91-12125# Wyle Labs., Inc., El Segundo, CA.

EVALUATION OF POTENTIAL DAMAGE TO UNCONVENTIONAL STRUCTURES BY SONIC BOOMS Final Report, Nov. 1988 - Jan. 1990

Louis C. Sutherland, Ron Brown, and Dawn Goerner May 1990 274 p

(Contract F08635-89-C-0044; AF Proj. 3037)

(AD-A225029; WR-89-14; HSD-TR-90-021) Avail: NTIS HC/MF A12 CSCL 01/2

Supersonic operations of U.S. Air Force aircraft cause sonic booms which may be the source of damage to unconventional structures. This problem is addressed in this report by (1) a literature survey of damage prediction and damage assessment techniques for such structures; (2) development of a statistical model for sonic boom overpressures with emphasis on supersonic operating areas (SOAs) employed for air combat maneuver training; (3) development of an analytical model to predict the probability of damage; (4) execution of a limited experimental program at White Sands Missile Range to evaluate response and potential damage of two unconventional structures in support of the prediction model; and finally (5) definition of algorithms for use in the Air Force ASAN computer program for evaluation of the probability of damage to unconventional structures from sonic booms. GRA

N91-12126# California Univ., Berkeley. Dept. of Materials Science and Mineral Engineering.

MODELING OF MICROMECHANISMS OF FATIGUE AND FRACTURE IN HYBRID MATERIALS Final Report, 15 Apr. 1987 - 14 Apr. 1990

L. H. Edelson, J.-K. Shang, S. C. Siu, K. T. VenkateswaraRao, and R. O. Ritchie 15 Jun. 1990 91 p

(Grant AF-AFOSR-0158-87; AF Proj. 2306)

(AD-A225042; UCB/R/90/A1065; AFOSR-90-0832TR) Avail: NTIS HC/MF A05 CSCL 11/6

The obvious benefits of the design of aerospace structures using lighter materials with high specific strengths and stiffnesses had led to the development of numerous reinforced composite metallic and intermetallic materials, which have become serious commercial competitors to traditional monolithic metallic alloys. While significant advances in processing technology have made the fabrication of such hybrid materials more of an economic reality, their widespread use in airframes or other structures has been limited by serious deficiencies in mechanical properties, particularly ductility, toughness and fatigue. This problem is compounded by the lack of fundamental studies which provide a rational basis for the underlying sources of crack-propagation resistance, and in particular which define the critical role of composite microstructure. GRA

N91-12127# Stanford Univ., CA. Dept. of Mechanical Engineering.

DYNAMIC INTERACTION OF ELASTIC COMPOSITES AND AN ACOUSTICS FLUID Final Report, 1 Jul. 1987 - 31 Dec. 1989

George Herrmann May 1990 9 p

(Contract N00014-85-K-0471)

(AD-A225056) Avail: NTIS HC/MF A02 CSCL 20/11

The follow topics are discussed: (1) One dimensional response of periodically layered composites in contact with an acoustic fluid; (2) Applicability of Floquet theory to bounded periodic domains; (3) Two dimensional waves in anisotropic layered composites; (4) The surface impedance tensor (Rayleigh waves in anisotropic layered composites); (5) Rayleigh-Lamb waves in anisotropic layered composites; (6) Scholte-Gogoladze type waves at the interface between a fluid and an anisotropic layered composite; and (7) An algorithm for the computation of the surface impedance tensor of anisotropic layered media. GRA

N91-12128# Northwestern Univ., Evanston, IL. Dept. of Materials Science.

RESIDUAL STRESS AND DIFFRACTION ELASTIC CONSTANTS MEASUREMENTS WITH A PERSONAL COMPUTER

R. A. Winholtz and J. B. Cohen Jul. 1990 69 p

(Contract N00014-80-C-0116)

(AD-A225145; TR-27) Avail: NTIS HC/MF A04 CSCL 14/2

Software is described for the measurement of residual stresses and x ray elastic constants on a diffractometer under computer control. The computer and interfaces to the hardware are relatively inexpensive and may be set up with only moderate electronic and programming expertise. Both biaxial and triaxial stress measurements may be made to an operator specified error. Measurements of the x ray elastic constants may also be made to a pre-specified error. Additionally, programs for use in data collection are described which allow the data to be processed separately at a later time. GRA

N91-12129# Oak Ridge National Lab., TN.

FRACTURE MECHANICS OF INHOMOGENEOUS MATERIALS Foreign Trip Report

B. R. Bass 1 Oct. 1990 16 p

(Contracts DE-AC05-84OR-21400; DOE-1886-8011-9B)

(DE91-000690; ORNL/FTR-3738) Avail: NTIS HC/MF A03

Discussions were held with Japanese researchers concerning (1) the Elastic-Plastic Fracture Mechanics in Inhomogeneous Materials and Structures (EPI) Program, and (2) ongoing large-scale pressurized- thermal-shock (PTS) experiments in Japan. In the EPI Program, major activities in the current fiscal year include round-robin analyses of measured data from inhomogeneous base metal/weld metal compact-tension (CT) specimens fabricated from welded plates of A533 grade B class 1 steel. The round-robin task involves participants from nine research organizations in Japan and is scheduled for completion by the end of 1990. Additional experiments will be performed on crack growth in inhomogeneous CT specimens and three-point bend (3PB) specimens 10 mm thick. The data will be compared with that generated previously from 19-mm-thick-specimens. A new type of inhomogeneous surface-cracked specimen will be tested this year, with ratio of crack depth to surface length (a/c) satisfying 0.2 is less than or equal to (a/c) is less than or equal to 0.8 and using a 3PB type of applied load. Plans are under way to fabricate a new welded plate of A533 grade B class 1 steel (from a different heat than that currently being tested) in order to provide an expanded fracture-toughness data base. Other topics concerning fracture-prevention issues in reactor pressure vessels were discussed with each of the host organizations, including an overview of ongoing work in the Heavy-Section Steel Technology (HSST) Program. DOE

N91-12130# Messerschmitt-Boelkow-Blohm G.m.b.H., Schrobenhausen (Germany, F.R.).
MEASURING AND SIMULATION OF STEADY SHOCK WAVE PROFILES IN ARMCO IRON
Werner Arnold (Fraunhofer Inst. fuer Kurzzeitdynamik, Freiburg im Breisgau, Germany, F.R.) and Walter Sachs 1989 6 p Presented at Conference on Shock Compression of Condensed Matter, Albuquerque, NM, 14-17 Aug. 1989
(MBB-UA-1144-89-PUB; ETN-90-97855) Avail: NTIS HC/MF A02

Wave profiles in Armco iron were obtained with conventional planar impact technique. The free surface velocity was measured using a VISAR interferometric system. Maximum strain rates were determined from the plastic part of the wave profiles. The stress range covered the region between Hugoniot elastic limit and phase transition. From the data an improved U(sub s) - u(sub p) relation was obtained. Transient behavior was observed in the lower strain rate regime. A viscosity model was implemented in a finite element code and satisfactorily reproduced the wave profiles measures in the experiment. ESA

N91-12131# Technische Univ., Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt.
COMPARISON OF ANALYTICAL AND NUMERICAL CALCULATIONS OF LINEAR AND GEOMETRIC NONLINEAR RECTANGULAR PLATES Thesis [VERGLEICH VON ANALYTISCHEN UND NUMERISCHEN BERECHNUNGEN VON LINEAREN UND GEOMETRISCH NICHTLINEAREN RECHTECKPLATTEN]
Joachim Hildebrand Apr. 1990 105 p In GERMAN
(ILR-Mitt-239(1990); ETN-90-97910) Avail: NTIS HC/MF A06

Compared calculation of displacement and forces on plates are carried out, using numerical and analytical computing processes. The numerical calculation, is concerned with a mixed finite process and a finite element program, on the basis of the deformation value process. The linear treatment of the analytical calculation and the nonlinear treatment were carried out. The numerical treatment of the Levy analytical solution is the central point of the task. The comparison of the used calculation process concerning preparation, calculation time, and results gives a criterion for the choice of a possible solution in the treatment of plate problems. ESA

N91-12132# Washington Univ., Seattle. Dept. of Mechanical Engineering
A SEM PROCEDURE FOR QUANTIFYING TRANSGRANULAR FRACTURE IN BRITTLE MATERIAL
Wein-Joe Yang, Chang Te Yu, and Albert S. Kobayashi Jul. 1990 20 p
(AD-A225211; UWA/DME/TR-90/3) Avail: NTIS HC/MF A03 CSCL 11/2

A Scanning Electron Microscopy (SEM) procedure for quantifying the percentage area of transgranular fracture was developed for studying the fracture morphologies of stable and rapid crack growths in ceramics and ceramic matrix composites. The procedure utilizes SEM line scanning profiles which are scanned and then interpreted as percentage area of transgranular fracture and surface roughness through a special software. This procedure was used to quantify the percentage area of transgranular fracture and surface roughness which were correlated with the visual observations and profilometer measurements respectively, of Al2O3 and SiC(w)/Al2O3 fracture specimens. Dynamic fracture of quasi-brittle metals and polymers are characterized by crack velocity versus stress intensity factor (SIF) relations which represent a gamma curve with distinct crack arrest SIF's. GRA

N91-12133# Naval Postgraduate School, Monterey, CA.
EXPERIMENTAL STUDIES OF CIRCULAR VISCOELASTIC WAVEGUIDE ABSORBERS FOR PASSIVE STRUCTURAL DAMPING M.S. Thesis
Stephen J. Watson Dec. 1989 72 p
(AD-A225409) Avail: NTIS HC/MF A04 CSCL 20/11

The U.S. Navy continues to investigate and develop better methods for ship noise and vibration reduction. One such method is the introduction of waveguide absorbers. This research is a continuation with the use of viscoelastic waveguide absorbers as a means of reducing the vibrational energy developed within a plate like structure, such as a ship's hull between frames and longitudinals. The effects of temperature and size of circular viscoelastic waveguide absorbers, on the driving point impedance were studied and the test results were compared with a previously developed computer prediction model with very favorable agreement. A study for the development of the scheme for the selection of waveguide absorbers and for the decision of the attachment locations for the maximum vibration reduction based on the waveguide absorber loss factor equation was also performed. One, two, and three waveguide absorbers were attached to a vibrating plate velocity, to confirm the use of the loss factor equation. Experimental results showed significant reduction of vibration at resonant frequencies. GRA

N91-11830# Societe Europeenne de Propulsion, Vernon (France).
STUDY OF THE EFFECTS OF POST HEAT TREATMENT ON THE RESIDUAL STRESSES IN ELECTRON BEAM WELDS OF TANKS SHELL IN TITANIUM
D. Baralle, J. Lu, B. Miege, and J. F. Flavenot (Centre Technique des Industries Mecaniques, Senlis, France) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 123-126 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11866# Politecnico di Torino (Italy). Dept. of Aerospace Engineering.
BUCKLING OF LAMINATED CYLINDRICAL PLATES INCLUDING EFFECTS OF SHEAR DEFORMATION
G. Romeo, C. Alonso, and A. Pennavaria *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 365-370 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11867# Fokker B.V., Amsterdam (Netherlands).
A SIMPLIFIED METHOD TO ESTIMATE COMPRESSION ALLOWABLES FOR COMPOSITE STIFFENED PANELS
J. H. vanderSloot *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 371-379 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11868# Fokker B.V., Amsterdam (Netherlands).
THE INFLUENCE OF MATERIAL PROPERTIES ON DESIGN VALIDITY AND MARGINS
M. P. Nieuwenhuizen *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 381-391 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11869# Fokker B.V., Amsterdam (Netherlands).
DETERMINATION OF MATERIAL DESIGN ALLOWABLES
C. A. Hermens *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 393-395 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N91-12134# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

UTILIZATION OF REMOTE SENSING TECHNIQUES IN GEOLOGICAL AND SEMIDETAILED WORK IN THE QUADRILATERO FERRIFERO REGION, MG M.S. Thesis, 26 Nov. 1986 [UTILIZACAO DE TECNICAS DE SENSORIAMENTO REMOTO EM TRABALHO GEOLOGICO DE SEMIDETALHE NA REGIAO DO QUADRILATERO FERRIFERO MG]

Maria daGloriaAlves Apr. 1987 135 p In PORTUGUESE; ENGLISH summary

(INPE-4151-TDL/268) Avail: NTIS HC/MF A07

This work applied photointerpretation technique, by using multiple scale products, for geologic-structural, regional, and semidetailed mapping in the east part of Quadrilatero Ferrifero (MG). The region presents geoscientific interest and geoeconomic importance due to the occurrence of iron ore, gold, and manganese. The products of remote sensors used, owing to their adequacy for the objectives of the work, were: normal color and infrared false-color aerial photographs of Mission 96; TM imagery (orbital) in bands 3, 4, 5, and 7; and magnetic tape with data from LANDSAT. The methodology used is based on a sequence of steps that show the logic and systematics under which the textural properties of relief and drainage features are analyzed. As a result, geologic-structural mays were drawn on the scale of 1:100,000 (based on TM imagery information) and 1:50,000 (based on aerial photographs). The use of TM/LANDSAT imagery on the scale of 1:100,000 allowed the individualization of most of geological units and made their regional structural behavior recognition easier. The use of aerial photographs added information to the visual interpretation obtained with TM imagery, since more subunits were differentiated and delimitated with this product in the Espinhaco, Minas, Rio das Velhas Supergroups, and Migmatitic-Granulitic complex of MG than with the TM imagery. The digital analysis was an additional mean that pointed out some geological features and completed the visual interpretation made with the visual interpretation made with the original TM imagery. Through the analysis of the products used and specific field data, it was possible to reach the individualization of the Magmatitic-Granulitic Complex of MG, the eastern continuations of Rio das Velhas Greenstone Belt, erosion relicts in Minas and Espinhaco Supergroups, ultramafic and basaltic metamagmatitos, and magmatitos and alluvion deposits. Author

N91-12135 Bristol Univ. (England).

USE OF SATELLITE REMOTE SENSING OF CLOUD AND RAINFALL FOR SELECTED OPERATIONAL APPLICATIONS IN THE FIELDS OF APPLIED HYDROLOGY AND FOOD PRODUCTION Ph.D. Thesis

Clare Power 1989 588 p

Avail: Univ. Microfilms Order No. BRDX89379

The use of satellite remote sensing techniques for selected applications in the fields of cloud, rainfall, vegetation and food production monitoring and assessment was studied. Detailed literature reviews were carried out on remote sensing techniques in these fields. Five different and contrasting satellite rainfall monitoring techniques were examined using visible and/or infrared imagery, three applied over the Sultanate of Oman and two over West Africa. The case studies applied over the Sultanate of Oman show a range of techniques from manual nephanalyses of Potential Rain Clouds and the derivation of a 20 year record of Tropical Cyclone tracks over the Arabian Sea, to the manual Bristol rainfall monitoring technique and its human-machine interactive successor BIAS, which are applicable to the analysis of short term extreme rainfall events. The remaining two techniques Polar-orbiter Effective Rainfall Monitoring Technique (PERMIT) and Agricultural Drought Monitoring Integrated Technique (ADMIT) were developed simultaneously over West Africa. The development, testing on data from July and August 1985 and July 1986, and subsequent modification of the PERMIT technique is described. The 1986 Case Study results were compared with the ADMIT results from the same data set. PERMIT was designed to be an economic, automatic rainfall estimation technique suitable for use in environments where computer facilities are limited. Finally the PERMIT rainfall products were compared with contemporaneous NOAA AVHRR Normalized Vegetation Index monthly composites. The main conclusion drawn from this research is that there is an urgent need for simple but effective rainfall and vegetation monitoring systems such as PERMIT, to be implemented operationally on low cost portable microcomputer systems.

Dissert. Abstr.

N91-12136*# Wyoming Univ., Laramie. Dept. of Atmospheric Science.

A COMPARISON OF SURFACE SENSIBLE AND LATENT HEAT FLUXES FROM AIRCRAFT AND SURFACE MEASUREMENTS IN FIFE 1987

Robert D. Kelly, Eric A. Smith, and J. Ian MacPherson (National Academy of Sciences - National Research Council, Washington, DC.) 1990 19 p

(Grant NAG5-913)

(NASA-CR-187365; NAS 1.26:187365) Avail: NTIS HC/MF A03 CSCL 08B

Surface fluxes of sensible and latent heat over a tall-grass prairie in central Kansas, as measured by 22 surface stations during FIFE 1987, are compared with values gained indirectly by linear extrapolation of aircraft-measured flux profiles to the surface. The results of 33 such comparisons covering the period 26 June to 13 October 1987 indicate that the sensible heat flux profiles were generally more linear with less scatter in the measurements at each level than were the latent heat flux profiles, the profile extrapolations of sensible heat flux in general underestimate the surface averages by about 30 percent, with slightly better agreement during periods of small flux, and the profile extrapolations of latent heat flux in general underestimate the surface averages by about 15 percent, with overestimates during periods of small fluxes (dry conditions) and overestimates during periods of large fluxes (moist conditions). Possible origins of the differences between the two sets of measurements are discussed, as directions for further research. Author

N91-12137# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

STUDY OF DATA INTEGRATION TECHNIQUES FOR GEOLOGICAL MAPPING IN THE IGUARACI (PE) REGION [ESTUDOS DE TECNICAS DE INTEGRACAO DE DADOS PARA O MAPEAMENTO GEOLOGICO NA REGIAO DE IGUARACI (PE)]

Sebastiao Milton PinheirodaSilva and Paulo Veneziani May 1990 8 p In PORTUGUESE; ENGLISH summary Presented at the 5th Brazilian Symposium on Remote Sensing, Natal, Brazil, 11-15 Oct. 1988

(INPE-5074-PRE/1593) Avail: NTIS HC/MF A02

The existing geophysical and petrographical data obtained by the basic geological mapping program (PLGB) of DNPM and executed by CPRM in the Iguaraci (PE) region, west of the Mulungu Mountain, called up the integration study of the multispectral TM/LANDSAT-5 and the data for geologic mapping. The study area is the proterozoic lithostratigraphic units including the Pajeu-Paraiba fold system (metavolcanic-sedimentary rocks), and the Archaean metamorphic rocks of the Gneissic-Migmatitic Complex in which the magmatic, granodicritic, and granitic rocks are scattered. The area is characterized by an extreme complexity of metamorphic and structural evolution. The following procedures were used: (1) photointerpretation of the TM/LANDSAT products; (2) digital analysis by band-ratio process; and (3) integration of 1 and 2 with geophysical and petrographical data. The preliminary results demonstrate that the data integration technique is a good

tool for assisting geological mapping, because it permits lithological discrimination. Author

N91-12138# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
CONTRIBUTION OF SATELLITE DATA IN THE CROP FORECASTING SYSTEM [CONTRIBUICAO DE DADOS DE SATELITE NO SISTEMA DE PREVISAO DE SAFRAS]
Sherry ChouChen May 1990 10 p In PORTUGUESE; ENGLISH summary Presented at the seminar on Estimate of Terrestrial Biomass and Agricultura Production by Satellite, 7-8 Jul. 1990, Brazil
(INPE-5087-PRE/1595) Avail: NTIS HC/MF A02

Various studies demonstrated that data obtained from natural resources satellites can be used to improve the quality of agriculture statistics through the regression estimator. Experience acquired from a cooperation project INPE-IBGE, using LANDSAT-TM data for crop forecasting study, is presented. Considerations which have to be taken into account to implement this system operationally are also discussed. Author

N91-12139# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
MAPPING OF VEGETATION/LAND USE OF INDIGENOUS AREAS UTILIZING TM/LANDSAT DATA [MAPEAMENTO DA VEGETACAO/USO DA TERRA DE AREAS INDIGENAS UTILISANDO-SE DADOS TM/LANDSAT]
Pedro HernandezFilho and Kleber deFaria Jul. 1990 47 p In PORTUGUESE; ENGLISH summary Presented at Project Macuxi, INPE/FUAI Convention, 24 Jun. 1988
(INPE-5115-RPE/626) Avail: NTIS HC/MF A03

The objective of this work is to provide environmental information about indigenous areas (Ananas Ponta da Serra, Cajueiro, Ouro, Araca, Serra da Moca, Recanto da Saudade). The study area is located in Boa Vista, Bonfim, and Alto Alegre municipalities in Roraima Territory, Brazil. The color composite 3, 4 and 5 photographic product, at the scale of 1:50,000 was used. Based on visual analysis of TM/LANDSAT data, several classes of vegetation associated with the land use were defined. The results show the possibilities and limitations of spatial technology to know the land use and environment risk. Author

N91-12140 California Univ., Berkeley.
AIRBORNE ELECTROMAGNETIC SENSING OF SEA-ICE THICKNESS Ph.D. Thesis
Guimin Liu 1989 231 p
Avail: Univ. Microfilms Order No. DA9028931

Because of the resistive nature of sea ice and the conductive nature of sea water, Airborne Electromagnetic (AEM) equipment can be used to map sea-ice thickness in the Arctic. The AEM data can be interpreted to obtain the distance from the antenna to the ice-water interface while a laser device is used to measure the distance to the upper ice surface. The difference of these two quantities then yields the ice thickness. The objective is to develop a method to interpret the data acquired in areas of a rough ice-water interface, especially in regions of ice keels. Algorithm was developed to compute the AEM response for a given irregular ice-water interface using the integral equation approach. Using numerical results it is demonstrated how the AEM response changes with the keel shape and the operation frequency. Then by compiling model data, interpretation charts were constructed to extract ice keel parameters from the observed anomaly associated with a 2-D ice keel. In order to obtain the details of the geometry of an irregular ice-water interface, the theory of Occam's inversion was modified to invert the AEM data. Examples for synthetic and field data show that these methods are successful. Furthermore, the developed methods may be applied in the mapping of a covered conductive basement or in the evaluation of AEM topographic effects. Dissert. Abstr.

N91-12141# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
THE SPATIAL AND TEMPORAL VARIATIONS OF A THERMODYNAMIC STRUCTURE OVER A FORESTED AREA [STRUCTURE THERMODYNAMIQUE SPATIO-TEMPORELLE DANS UNE REGION FORESTIERE]
Ruberio PradoBritto Mar. 1990 23 p In PORTUGUESE; ENGLISH summary
(INPE-5033-RPE/618) Avail: NTIS HC/MF A03

An analysis of space and temporal variation of the thermodynamic structure over a forested area is presented. The study was performed based in the vertical variation of the thermodynamic profile, in the daily variation of the thermodynamic field for two different situations in the boundary layer (with and without advection) and finally analyzing the daily variation of the temperature and wind field over the forest canopy. Author

N91-12142# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
CHARACTERIZATION OF AN AGRICULTURAL REGION STARTING WITH AC BAND THERMAL INFRARED RADAR AND RADIOMETER AT AN AIRPORT [CARACTERISATION D'UNE REGION AGRICOLE A PARTIR D'UN RADAR BANDE C ET D'UN RADIOMETRE DANS L'INFRAROUGE THER MIQUE AEROPORTES]
Joao VianeiSoares and Rene Bernard et Dani Vidal-Madjar (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France) Jun. 1988 14 p In PORTUGUESE; ENGLISH summary Presented at the 16th Congress of International Society for Photogrammetry and Remote Sensing, Kyoto, Japan, 1-10 Jul. 1988 Submitted for publication
(INPE-4608-PRE/1331) Avail: NTIS HC/MF A03

Results are presented from a rural airport sited in La Beauce, France. The spatial properties are examined of superficial layer of humidity (estimated by a C band radar) and surface temperature (obtained by a radiometer at 8 to 12 microns) as well as their relationship to other conditions (humid and arid soil, exposed soil and vegetation covered soil). An agricultural plot is shown which is considered homogeneous in respect to these two measurements. In other respects, repeated measures of these two parameters are related by estimation of hydrological properties of soil. On the basis of 10 days of measurement, it is observed that the drainage properties change in parallel to each other. An estimate is made by making a model of two reservoirs of two properties which give a quantitative measure of their heterogeneity of the observed drainage: pseudodiffusivity and humidity which are representative of the average soil profile. Transl. by E.R.

N91-12143# Environmental Research Inst. of Michigan, Ann Arbor.
ALP FOPEN SITE DESCRIPTION AND GROUND TRUTH SUMMARY Technical Report, Oct. 1988 - Feb. 1990
E. Kasischke, D. M. Beverstock, N. H. French, and L. L. Bourgeau-Chavez Feb. 1990 372 p Sponsored by MIT, Lexington, MA
(Contract F19628-85-C-0002)
(AD-A224857; ERIM-211100-3-T) Avail: NTIS HC/MF A16
CSCL 17/9

An extensive set of multifrequency (1.25, 5.3 and 9.35 GHz), and in some cases polarimetric airborne Synthetic Aperture Radar (SAR) imagery was collected by the ERIM/NADC P-3 SAR System. The acronym for this data collection was ALP, which stands for AFWAL/LL/P-3. Test sites are considered which were established to more clearly understand the phenomenology associated with radar detection of targets obscured by vegetation. The test sites consisted of trihedral corner reflectors deployed in six different tree stands. Ground truth collected during this activity includes: (1) ground photography of each site; (2) climatic data for the experiment period; (3) measurement of tree density, diameter, height and placement relative to the target for each site; (4) for some cases, measurement of branch and needle biomass, diameter, angles and length; (5) allometric equations describing

the distribution of above ground biomass for the various tree species; and (6) dielectric measurements of the major tree species found within the test area. GRA

N91-12144# Army Cold Regions Research and Engineering Lab., Hanover, NH.
DEVELOPMENT OF AN AIRBORNE SEA ICE THICKNESS MEASUREMENT SYSTEM AND FIELD TEST RESULTS
Austin Kovacs and J. Scott Holladay Dec. 1989 56 p
(Contract N68452-86-MP-60003)
(AD-A224867; CRREL-89-19) Avail: NTIS HC/MF A04 CSCL 08/12

Recent efforts to improve airborne electromagnetic induction-measurement technology and to downsize the related helicopter-towed antenna assembly from about 7.5 m long to about 3.5 m long for use in airborne measurement of sea ice thickness are discussed, as are the results from arctic field testing. Also outlined are the system noise and drift problems encountered during arctic field evaluation, problems that adversely affected the quality of the sounding data. The sea ice sounding results indicate that it should be possible to determine thickness to within 5 percent for ice floes with moderate relief but that, because of sounding footprint size and current model algorithm constraints, steepsided pressure ridge keels cannot be well defined. The findings also indicate that routine sea ice thickness profiling from an airborne platform is close at hand with further system improvement, as is the apparent capability to determine the conductivity of the sea ice, from which an assessment of sea ice strength can be made. GRA

N91-12145# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.).
EXAMINATION AND MAPPING OF FOREST DAMAGES, USING REMOTE SENSING METHODS, PART A Final Report [ABSCHLUSSDOKUMENTATION: UNTERSUCHUNG UND KARTIERUNG VON WALDSCHAEDEN MIT METHODEN DER FERNERKUNDUNG, TEIL A]
G. Landauer, ed. and H.-H. Voss 8 Dec. 1989 250 p In GERMAN
(ETN-90-97888) Avail: NTIS HC/MF A11

The aim is to develop operational methods for using multispectral scanner data (aircraft, satellite) in order to indentify, classify, and represent (mapping) forest damage, with the long range objective of mapping using remote sensing satellites. The essential operational steps of the partial projects, were: the definition of spectral signals of the forest in connection with damage identification; the classification, according to forest stand and forest damage classes, on the basis of the signals; the mapping and the developing of comprehensive mapping algorithms. ESA

N91-12146# Bonn Univ. (Germany, F.R.). Inst. fuer Physik.
UTILIZATION OF GEODETIC MEASURING TECHNIQUES, USING THE ELECTRON-STRETCHER-ACCELERATOR (ELSA) OF BONN UNIVERSITY (FEB. REPUBLIC OF GERMANY) Thesis [ANWENDUNG GEODAETISCHER MESSTECHNIKEN AM BEISPIEL DER ELEKTRONEN-STRETCHER-ANLAGE (ELSA) DER UNIVERSITAET BONN]
Wolfgang Schauerte Jun. 1990 130 p In GERMAN; ENGLISH summary
(Bonn-IR-90-23; ISSN-0172-8741; ETN-90-97907) Avail: NTIS HC/MF A07

A measuring concept for adjusting the magnet elements of the Electron-Stretcher-Accelerator (ELSA) is presented. It provides the required high accuracy of less than 0.3 mm. To solve the inherent problems, various measuring methods and instruments were used. The criteria of their selection and operation were determined on the basis of extensive pre-investigations and a large scale calibration program. For example, oscillation measurements were carried out at different fix points of the geodetic ELSA-net, in order to find out the influence of disturbing sources (street traffic, cooling machines, heavy duty cranes, etc.). A measuring system is presented which allows these oscillation signals to be measured, stored and analyzed. Investigations on the influence of the magnetic fields on compensators of automatic levels are presented. A calibration unit and different measuring methods were developed to investigate the influence of slight dc and/or ac magnetic fields less than 19 muT on the orientation of the line of collimation. ESA

N91-12147# European Space Agency, Paris (France).
REPORT OF THE DEAUVILLE CONFERENCE ON EDUCATION AND APPLICATIONS: A PLANNING MEETING FOR THE INTERNATIONAL SPACE YEAR 1992
Duc T. Guyenne, ed. Apr. 1990 79 p Conference held in Deauville, France, 12-15 Feb. 1990; sponsored by ESA, French Ministry of Foreign Affairs, and French Ministry of Cooperation and Development Original contains color illustrations
(ESA-SP-1130; ISBN-92-9092-092-0; ETN-90-97993) Copyright Avail: NTIS HC/MF A05

The development of proposals and recommendations for SAFISY (Space Agency Forum on the International Space Year) education and applications activities was addressed. Objectives, the approach, intended result(s), schedule and organization of the following working groups are presented. Under the theme of training in remote sensing applications: vegetation resources, monitoring and management; geology, natural hazards; urban and environmental planning. Under the theme of space and education: Earth observation in education; space science in education; space communications in education. ESA

N91-12148# Beleidscommissie Remote Sensing, Delft (Netherlands).
SPATIAL IMAGE PATTERN ANALYSIS AND BASIC SOIL PROPERTIES OF NATURAL VEGETATION [RUIMTELIJKE PATROONANALYSE IN BEELDEN EN GRONDGEGEVENS VAN NATUURLIJKE VEGATATIE]
R. J. Bijlsma and E. J. vanKootwijk (Research Inst. for Nature Management, Arnhem, Netherlands) Apr. 1990 23 p In DUTCH
(BCRS-90-01; ETN-90-97691) Avail: NTIS HC/MF A03

The status of the study of texture characteristics in digital remote sensing pictures of natural vegetations is depicted. The fundamentals of spatial variability and the methods used for its study are outlined. Texture analysis, scale and resolution, and sampling strategy are discussed. The legends of the vegetation maps are presented. The modeling of the scene (describing the Earth surface patterns) and the relation between scene and image are discussed. This scene model allows image simulations. A proposal for pattern extraction from field data with a view to image processing is given. ESA

N91-12149# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Fernerkundung.
THEMATIC MAPPER LANDUSE CLASSIFICATION AS A REMOTE SENSING CONTRIBUTION FOR A HYDROLOGIC RUNOFF PREDICTION MODEL Ph.D. Thesis - Trier Univ.
Stefan Kleeschulte Mar. 1990 128 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1238) Original contains color illustrations
(DLR-FB-90-16; ISSN-0171-1342; ETN-90-98040) Copyright Avail: NTIS HC/MF A07; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 42 Deutsche marks

The utilization possibilities for high geometrical resolution satellite data for quantification of the high water runoff are shown. In combination with a digital landscape model with the same resolution it was possible to obtain detailed information from a precipitation runoff model. A small drainage area could be analyzed by comparing the measured and calculated hydrographs for the same present precipitation events. Simulation were achieved for possible future developments in the watershed, which take into account changes in runoff due to forest damages, agriculture and urbanization effects. ESA

N91-12150# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Science.
MARVEL: A SYSTEM FOR RECOGNIZING WORLD LOCATIONS WITH STEREO VISION Ph.D. Thesis
David Jerome Braunegg Jun. 1990 248 p
(Contracts N00014-85-K-0124; N00014-86-K-0685; DACA76-85-C-0010)
(AD-A225709; AI-TR-1229) Avail: NTIS HC/MF A11 CSCL 12/9

To use a world model, a mobile robot must be able to determine its own position in the world. To support truly autonomous navigation, I present MARVEL, a system that builds and maintains its own models of world locations and uses these models to recognize its world position from stereo vision input. MARVEL is designed to be robust with respect to input errors and to respond to a gradually changing world by updating its world location models. I present results from real-world tests of the system that demonstrate its reliability. MARVEL fits into a world modeling system under development. GRA

N91-11974*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Tracking Systems and Applications Section.
THE FIRST GEOCENTER ESTIMATION RESULTS USING GPS MEASUREMENTS
R. P. Malla (Sterling Software, Pasadena, CA.) and S. C. Wu *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 1-9 (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 08E

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N91-12151*# George Mason Univ., Fairfax, VA. Dept. of Electrical and Computer Engineering.
LASER ANNEALING OF AMORPHOUS/POLY: SILICON SOLAR CELL MATERIAL FLIGHT EXPERIMENT Final Report, Oct. 1989 - Jun. 1990
Eric E. Cole Jun. 1990 31 p
(Grant NAG5-1294)
(NASA-CR-187370; NAS 1.26:187370) Avail: NTIS HC/MF A03 CSCL 10A

The preliminary design proposed for the microelectronics materials processing equipment is presented. An overall mission profile, description of all processing steps, analysis methods and measurement techniques, data acquisition and storage, and a preview of the experimental hardware are included. The goal of the project is to investigate the viability of material processing of semiconductor microelectronics materials in a micro-gravity environment. The two key processes are examined: (1) Rapid Thermal Annealing (RTA) of semiconductor thin films and damaged solar cells, and (2) thin film deposition using a filament evaporator. The RTA process will be used to obtain higher quality crystalline properties from amorphous/poly-silicon films. RTA methods can also be used to repair radiation-damaged solar cells. On earth this technique is commonly used to anneal semiconductor films after ion-implantation. The damage to the crystal lattice is similar to the defects found in solar cells which have been exposed to high-energy particle bombardment. Author

N91-12152# Technische Univ., Delft (Netherlands). Lab. for Measurement and Control.
AN INTEGRATED DYNAMIC MODEL OF A FLEXIBLE WIND TURBINE
Peter M. M. Bongers, Wim A. A. Bierbooms, Sjoerd Dijkstra, and Theo vanHolten (Stork Product Engineering, Amsterdam, Netherlands) 1990 122 p
(Grants ENW3-0044-NL; NOVEM-41/33-020/10)
(MEMT-6; UDC-621.548; ISBN-90-370-00371-1; ETN-90-97753)
Copyright Avail: NTIS HC/MF A06

A model to study the dynamic behavior of flexible wind turbines was developed. The different subsystems of the wind turbine are individually modeled with about the same degree of accuracy. The aerodynamic part describes wind shear, gravity effects, unsteady effects, and dynamic inflow. The rotor blades are provided with degrees of freedom in lag and flap directions. The tower construction is modeled including the first bending mode. The first torsional mode of the transmission is included in the model. The model of synchronous generator with dc link consists of a nonlinear fourth order model, including saturation effects. The different models of the subsystems are coupled into one integrated dynamic model which is implemented as simulation code in the DUWECS (Delf University Wind Energy Converter Simulation Package) program. The DUWECS program is developed in such a manner that it is an easy to handle tool for the study of the dynamic features of wind turbine systems. ESA

N91-12153# Army Construction Engineering Research Lab., Champaign, IL.
PERFORMANCE OF AN ICE-IN-TANK DIURNAL ICE STORAGE COOLING SYSTEM AT FORT STEWART, GEORGIA
Chang W. Sohn, Gerald Cler, and Robert J. Kedl Jun. 1990 39 p Sponsored by Army Engineering and Housing Support Center, Fort Belvoir, VA
(AD-A224739; CERL-TR-E-90/10) Avail: NTIS HC/MF A03 CSCL 10/4

Diurnal cold storage cooling systems provide an effective means for reducing peak electrical demand at Army installations. The U.S. Army Construction Engineering Research Laboratory demonstrated an ice-in-tank diurnal ice storage (DIS) cooling system at the Post Exchange building, Fort Stewart, GA in April 1987 as part of the Facility Engineering Applications Program (FEAP). Design and construction of the system were documented elsewhere. The system was instrumented during the 1987 cooling season to test its performance. The system energy performance, peak shaving capability, operation and maintenance experience is documented along with and lessons learned from the Fort Stewart first year system operation. The efficacy of a DIS cooling system as a means of reducing peak electrical demand has been verified; however, generalization of performance for generic ice-in-tank systems is not recommended due to the limited amount of data available from only one system. GRA

N91-12154# Los Alamos National Lab., NM. Advanced Engineering Technology Div.
ADVANCED SYSTEM ANALYSIS FOR INDIRECT METHANOL FUEL CELL POWER PLANTS FOR TRANSPORTATION APPLICATIONS
Nicholas E. Vanderborgh, Robert D. McFarland, and James R. Huff 1990 9 p Presented at the 1990 Fuel Cell Seminar, Phoenix, AZ, 25-28 Nov. 1990
(Contract W-7405-eng-36)
(DE91-000171; LA-UR-90-3356; CONF-901106-1) Avail: NTIS HC/MF A02

The indirect methanol cell fuel concept actively pursued by the USDOE and General Motors Corporation proposes the development of an electrochemical engine (e.c.e.), an electrical generator capable for usually efficient and clean power production from methanol fuel for the transportation sector. This on-board generator works in consort with batteries to provide electrical power to drive propulsion motors for a range of electric vehicles. Success in this technology could do much to improve impacted environmental areas and to convert part of the transportation fleet to natural gas and coal derived methanol as the fuel source. These developments parallel work in Europe and Japan where various fuel cell powered vehicles, often fueled with tanked or hydride hydrogen, are under active development. Transportation applications present design challenges that are distinctly different

from utility requirements, the thrust of most of previous fuel cell programs. In both cases, high conversion efficiency (fuel to electricity) is essential. However, transportation requirements dictate as well designs for high power densities, rapid transients including short times for system start up, and consumer safety. The e.c.e. system is formed from four interacting components: (1) the fuel processor; (2) the fuel cell stack; (3) the air compression and decompression device; and (4) the condensing cross flow heat exchange device. DOE

N91-12155# Naval Postgraduate School, Monterey, CA.
POWER RECOVERY OF RADIATION-DAMAGED GALLIUM ARSENIDE AND INDIUM PHOSPHIDE SOLAR CELLS M.S. Thesis
Corinne Cypranowski Dec. 1989 155 p
(AD-A225307) Avail: NTIS HC/MF A08 CSCL 10/2

Radiation damaging to on-orbit solar arrays was found to significantly decrease power output and efficiency. By a process of annealing, these cells can recover some of the initial performance parameters. Gallium Arsenide (GaAs) and Indium Phosphide (InP) solar cells were subjected to 1 MeV electron radiation by a Dynamitron linear accelerator at two fluence levels of 1E14 and 1E15 electrons/sq cm. The annealing process was varied by temperature, amount of forward biased current, light conditions and time. Both types of cells were found to be hardened to radiation; however, the InP cells were superior over the two. Multiple cycles of irradiating and annealing were performed to observe the amount of degradation and recovery. The results prove that substantial recovery will occur, particularly with the InP cells. Applying this process to on-orbit spacecraft utilizing solar arrays as the main source of power will significantly increase mission life and potentially decrease cost of the on-board power system. GRA

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N91-12156*# Texas A&M Univ., College Station. Surface Electrochemistry Lab.
ELECTROCHEMICAL INCINERATION OF WASTES Final Report, Jan. 1987 - Dec. 1989
L. Kaba, G. D. Hitchens, and J. OM. Bockris Dec. 1989 96 p
(Grant NAGw-1779)
(NASA-CR-186317; NAS 1.26:186317) Avail: NTIS HC/MF A05 CSCL 13B

The disposal of domestic organic waste in its raw state is a matter of increasing public concern. Earlier, it was regarded as permissible to reject wastes into the apparently infinite sink of the sea but, during the last 20 years, it has become clear that this is environmentally unacceptable. On the other hand, sewage farms and drainage systems for cities and for new housing developments are cumbersome and expensive to build and operate. New technology whereby waste is converted to acceptable chemicals and pollution-free gases at site is desirable. The problems posed by wastes are particularly demanding in space vehicles where it is desirable to utilize treatments that will convert wastes into chemicals that can be recycled. In this situation, the combustion of waste is undesirable due to the inevitable presence of oxides of nitrogen and carbon monoxide in the effluent gases. Here, in particular, electrochemical techniques offer several advantages including the low temperatures which may be used and the absence of any NO and CO in the evolved gases. Work done in this area was restricted to technological papers, and the present report is an attempt to give a more fundamental basis to the early stages of a potentially valuable technology. Author

N91-12157# Radian Corp., Research Triangle Park, NC.
EMISSIONS AND COST ESTIMATES FOR GLOBALLY SIGNIFICANT ANTHROPOGENIC COMBUSTION SOURCES OF NOx, N2O, CH4, CO, AND CO2 Final Report, Apr. 1987 - Jan. 1990
S. D. Piccot, J. A. Buzun, and H. C. Frey May 1990 125 p
(Contract EPA-68-02-4288)
(PB90-216433; EPA/600/7-90/010) Avail: NTIS HC/MF A06 CSCL 13B

The report discusses the development of emission factors for CO2, CO, CH4, NO(x), and N2O for about 80 globally significant combustion sources in seven source categories: utility, industrial, fuel production, transportation, residential, commercial, and kilns/ovens/dryers. Because of the lack of adequate international data, the emission factors for most sources are based on U.S. performance, cost, and emissions data. Data on CO2, CO, and NO(x) were available for over 90 percent of the sources studied: on CH4, for about 80 percent; and on N2O, for only about 10 percent. Emission factor quality ratings were developed to indicate the overall adequacy of the supporting data. Evaluation of the emission factors for the seven source categories (taking the five gases as an aggregate for each category) showed that the kilns/ovens/dryers category had the lowest overall quality rating. GRA

N91-12158# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
HYDROCHEMISTRY OF SOLUTIONS AT THE ATMOSPHERE-SOIL INTERFACE AT A TERRA-FIRMA (CENTRAL AMAZON) FOREST ECOSYSTEM Ph.D. Thesis - Inst. of Astronomy and Geophysics. [HIDROQUIMICA DAS SOLUCOES NA INTERFACE ATMOSFERA-SOLO NUM ECOSSISTEMA DE FLORESTA DE TERRA-FIRME (AMOZONIA CENTRAL)]
Maria Cristina Forti May 1990 170 p In PORTUGUESE; ENGLISH summary
(INPE-5095-RPE/625) Avail: NTIS HC/MF A08

In a terra firme ecosystem in Central Amazonia (near Manaus), the ions Na(+), K(+), Mg(2+), Ca(2+), NH4(+), Cl(-) and SO4(2-), and pH measurements were done in rainwater, throughfall, soil solution (saturated and unsaturated zones), and surface water (igarape) samples. Collections were performed in the Reserva Ducke, a preserved forested area, 25 km at the Northeast of Manaus, in the Manaus-Itacoatiara road (AM-10), during one wet period (April/May) and one dry period (August/September) in 1987. This work analyzes the chemical composition variation pattern in the ecosystem solution in these two contrasting seasons. The cations were analyzed by atomic absorption spectrometry and the anions were analyzed by liquid ion chromatography. The rainwater input are two times greater for the Na(+), Mg(2+), NH4(+) and SO4(2-) and about four times greater for the K(+) during the dry period. The ionic concentration in throughfall are richer than those in rainwater, except for the ion NH4(+), during the dry period. This enrichment was attributed to the canopy washing and to the leaching of the vegetal tissue by rainwater. It was noticed that the soil is enriched in relation to throughfall. The rainwater and river water ionic content are lower during the wet period than those of the dry one. Author

N91-12159 Maryland Univ., College Park.
REACTIVE NITROGEN COMPOUNDS IN THE TROPOSPHERE: OBSERVATIONS, TRANSPORT, AND PHOTOCHEMISTRY Ph.D. Thesis
Winston Thomas Luke 1990 496 p
Avail: Univ. Microfilms Order No. DA9030945

Oxides of nitrogen critically control the photochemical production of ozone and account for approximately 1/3 of the total acid deposition in North America. The results of three studies are presented designed to enhance knowledge of the distribution, transport, and photochemistry of reactive (or odd) nitrogen compounds in the troposphere. Concentrations of odd nitrogen were measured in both urban and rural air advected from the polluted east coast of North America to the western Atlantic ocean.

Reactive nitrogen compounds, carbon monoxide, and ozone were measured over the central United States. Vertical profiles of reactive nitrogen compounds show dramatic perturbations due to the effects of violent convective activity. The photolysis rate coefficients of several alkyl nitrates (RONO2) to NO2 and the alkoxy radical were measured directly with a chemiluminescence detector. The rate of removal of RONO2 from the troposphere is dominated by photolysis and reaction with the hydroxyl radical. Overall lifetimes of RONO2 are of the order of weeks, making RONO2 important reservoir species whose photolysis may enhance the rate of photochemical ozone production in the remote troposphere. Dissert. Abstr.

N91-12160 Johns Hopkins Univ., Baltimore, MD.
OPTIMUM DESIGN OF AIR POLLUTION MONITORING NETWORKS: A MATHEMATICAL PROGRAMMING APPROACH Ph.D. Thesis
Arturo Trujillo-Ventura 1990 195 p
Avail: Univ. Microfilms Order No. DA9030260

Objective functions are introduced that provide metrics for the spatial coverage of the network and its ability to detect violation of standards for multiple pollutants. An additional objective regarding robustness of the design is also considered. The use of multiobjective programming techniques allows the designer to generate a series of noninferior solutions until a best compromise solution is found. The numerical difficulties presented by such a formulation are discussed and solutions are proposed that are cost-effective. Variants of the basic design, such as the absence of the measuring instruments for a certain pollutant in one or several of the stations are also allowed. Furthermore, the model provides information about which instrument can be eliminated with minimum loss of information. The definitions adopted for the objective functions yield great flexibility of the model. In particular, three extensions of the basic model dealing with common practical situations are also presented: (1) for the case where there are notable seasonal variations in air pollution patterns; (2) for the situations where certain areas of the domain monitored are unavailable to locate measurement stations; and (3) for cases where the network designed is the expansion of an already existing system. The basic model and its extensions are applied to the design of a network in the area surrounding Tarragona (Spain). Dissert. Abstr.

N91-12161# Pittsburgh Univ., PA. Dept. of Physics and Astronomy.
KINETICS OF ORGANOPHOSPHATE REACTIONS Final Report, Jun. 1987 - Jun. 1989
Rainer Johnsen 19 Apr. 1990 26 p
(Contract F33615-87-C-2754)
(AD-A225269; WRDC-TR-90-2024) Avail: NTIS HC/MF A03 CSCL 07/3

Rate coefficients and production yields were determined for ion-molecule reactions of several atmospheric ions with dimethyl-methlphosphonate (DMMP). The measurements were carried out using a selected-ion drift-tube mass spectrometer. Most reactions are found to proceed by dissociative charge transfer. Those of nitric oxide ions in the electronic ground state occur by three-body association, those of hydronium ions occur by proton transfer. GRA

N91-12162# Defence Research Establishment Suffield, Ralston (Alberta).
LASER DETECTION AND MAPPING OF BIOLOGICAL SIMULANTS 3. DICHOTOMOUS SAMPLER MEASUREMENTS OF AEROSOL CONCENTRATIONS AS RELATED TO LIDAR SIGNALS
J. Ho, B. T. Evans, and G. Roy (Defence Research Establishment Valcartier, Quebec) Jun. 1990 35 p
(AD-A225321; DRES/SUFFIELD-532; PCN-351SQ) Avail: NTIS HC/MF A03 CSCL 15/6

In a continuing series of investigations on biological aerosol detection by the Laser Cloud Mapper (LCM), reliable measurement of biological aerosol concentrations were found to be critical to LCM data interpretations. The sampling method must give reproducible results under difficult field conditions of rapidly changing environmental parameters. A series of trials were conducted to evaluate the Dichotomous Sampler (DS) as a device for the sampling of biological aerosols and to assess its potential for the estimation of biological aerosol concentrations during LCM trials. Sampled biological aerosols were enumerated as viable cells and provided reliable estimates of viable aerosol concentrations with respect to time. Interpretation of DS and LCM data demonstrated a relationship between cell concentrations and depolarization signal ratios which suggests that this technique has potential for remote biological aerosol detection at the 200 to 400 viable spores/liter level. GRA

N91-12163# Purdue Univ., West Lafayette, IN. Dept. of Medicinal Chemistry.
A TOLUENE MODEL FOR HYDROCARBON RISK ASSESSMENT Final Technical Report, 1 Jan. - 31 Dec. 1989
James Morre 29 May 1990 8 p
(Grant AF-AFOSR-0219-89; AF Proj. 2312)
(AD-A225358; AFOSR-90-0811TR) Avail: NTIS HC/MF A02 CSCL 21/4

This project was for continuation of research to investigate the molecular mode of action of a membrane-active hydrocarbon, toluene, potentially present in the Air Force environment as a flight fuel component or from other sources and to serve as a model for other membrane-active molecules in the environment. Two important target sites were identified where rapid dose-dependent but reversible changes in the membrane organization occurred at low dose levels. One of these was at the plasma membrane where the ability of the membrane to form protuberances was severely compromised. The other concerned a failure to form protuberances by membranes involved in internal trafficking between the endoplasmic reticulum and the Golgi apparatus. This step was reproduced in a cell-free system making detailed studies possible. The toluene inhibited step was identified as dependent on ATP hydrolysis. The involved ATPase activity was characterized, solubilized and partially purified. GRA

N91-12477*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, NY.
COMPARISON OF SOLAR AND OTHER INFLUENCES ON LONG-TERM CLIMATE
James E. Hansen, Andrew A. Lacis, and Reto A. Ruedy *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 135-145 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 13B

N91-12478*# National Oceanic and Atmospheric Administration, Boulder, CO. Aeronomy Lab.
SOLAR ACTIVITY AND THE SEA-SURFACE TEMPERATURE RECORD-EVIDENCE OF A LONG-PERIOD VARIATION IN SOLAR TOTAL IRRADIANCE
George C. Reid *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 146-148 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 13B

N91-12479*# Climate Analysis Center, Washington, DC.
JANUARY-FEBRUARY TROPOSPHERIC CLIMATE FOR THE NORTHERN HEMISPHERE AND THE 11-YEAR SOLAR CYCLE, THE QBO AND THE SOUTHERN OSCILLATION
Anthony G. Barnston and Robert E. Livezey *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 149-163 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 13B

N91-12480*# Arizona Univ., Tucson. Lunar and Planetary Lab.
A MECHANISM INVOLVING SOLAR ULTRAVIOLET VARIATIONS FOR MODULATING THE INTERANNUAL CLIMATOLOGY OF THE MIDDLE ATMOSPHERE

L. L. Hood and J. L. Jirikowic *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 164-172 (For primary document see N91-12456 03-92)
(Grant NAGw-909)
Avail: NTIS HC/MF A16 CSCL 13B

N91-12488*# Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
WHAT COULD BE CAUSING GLOBAL OZONE DEPLETION
S. Fred Singer *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 235-240 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 13B

N91-12506*# Kitt Peak National Observatory, Tucson, AZ.
TRACKING ATMOSPHERIC TRACE GASES BY SPECTROSCOPY FROM KITT PEAK Abstract Only
Lloyd Wallace and William Livingston (National Solar Observatory, Tucson, AZ.) *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 365 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 13B

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N91-12164 Florida State Univ., Tallahassee.
ON THE DECADAL MODES OF OSCILLATION OF AN IDEALIZED OCEAN-ATMOSPHERE SYSTEM Ph.D. Thesis
Vikram Madhuvadan Mehta 1990 198 p
Avail: Univ. Microfilms Order No. DA9023923

Axially-symmetric, linear modes of global, primitive equation, ocean-atmosphere models are examined to see if they contain decadal oscillation time scale modes. A two-layer model of the global ocean and a two-level model of the global atmosphere are formulated. Both models are linearized about axially-symmetric basic states containing mean meridional circulations in the ocean and the atmosphere. The linearized perturbation system is solved as an eigenvalue problem. Uncoupled, axially-symmetric modes of oscillation of the ocean and the atmosphere are calculated. Axially-symmetric modes of the coupled ocean-atmosphere system are also calculated. Sensitivity of the results to various physical processes and parameter values are examined. Dissert. Abstr.

N91-12165# American Meteorological Society, Boston, MA.
ATMOSPHERIC PROCESSES OVER COMPLEX TERRAIN
Robert M. Banta, G. Berri, William Blumen, ed. (Colorado Univ., Boulder.), David J. Carruthers, G. A. Dalu, Dale R. Durran, Joseph Egger, J. R. Garratt, Steven R. Hanna, and J. C. R. Hunt et al Jun. 1990 323 p Presented at the Workshop on Current Direction in Atmospheric Processes Over Complex Terrain, Park City, UT, 24-28 Oct. 1988
(Contract DE-FG05-90ER-60954)
(DE90-017458; DOE/ER-60954/1; CONF-8810430; ISBN-1-87-8220-01-2; ISSN-0065-9401; LC-90-80548) Avail: NTIS HC/MF A14

A workshop on atmospheric processes over complex terrain, sponsored by the American Meteorological Society, was convened in Park City, Utah from 24 vto 28 October 1988. The overall objective of the workshop was one of interaction and synthesis--interaction among atmospheric scientists carrying out research on a variety of orographic flow problems, and a synthesis of their results and points of view into an assessment of the current status of topical research problems. The final day of the workshop was devoted to an open discussion on the research directions that could be anticipated in the next decade because of new and planned instrumentation and observational networks, the recent emphasis on development of mesoscale numerical models, and continual theoretical investigations of thermally forced flows, orographic waves, and stratified turbulence. This monograph represents an outgrowth of the Park City Workshop. The authors have contributed chapters based on their lecture material. Workshop discussions indicated interest in both the remote sensing and predictability of orographic flows. These chapters were solicited following the workshop in order to provide a more balanced view of current progress and future directions in research on atmospheric processes over complex terrain. DOE

N91-12166# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
MONITORING OF WATER MASERS FROM IRAS SOURCES
B. SestokasFilho and E. Scalise, Jr. May 1990 8 p Presented at the VI Regional Latin-American of the IAU Submitted for publication
(INPE-5055-PRE/1588) Avail: NTIS HC/MF A02

Twenty-three water vapor masers in the direction of IRAS sources in the Southern Hemisphere had their intensities monitored systematically at Itapetinga Radio Observatory. These masers were detected in four surveys in which each run had different selection criteria. The IRAS fluxes analysis and the shape of the spectra of these masers suggest that the objects are associated with premain sequence stars, still surrounded by the dust cocoon. Almost all sources presented drastic changes in the overall spectral line distribution in their spectra. Author

N91-12167# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
DIGITAL ELEVATION MODEL VISIBILITY INCLUDING EARTH'S CURVATURE AND ATMOSPHERE REFRACTION
Ewerton SantosSilva and Luiz Alberto VieiraDias Mar. 1990 10 p Submitted for publication
(INPE-5044-PRE/1574) Avail: NTIS HC/MF A02

There are some instances in which the Earth's curvature and the atmospheric refraction, optical or electronic, are important factors when digital elevation models are used for visibility calculations. This work deals with this subject, suggesting a practical approach to solve this problem. Some examples, from real terrain data, are presented. The equipment used was an IBM-PC like computer with a SITIM graphic card. Author

N91-12168# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
GEODESICS IN GOEDEL-TYPE SPACE-TIMES
M. O. Calvao, I. Damiao Soares, and J. Tiomno 1988 44 p
(DE90-634419; CBPF-NF-065/88) Avail: NTIS (US Sales Only) HC/MF A03

The geodesic curves of the homogeneous Goedel-type-space-times, which constitute a two-parameter (I and omega) class of solutions presented to several theories of gravitation (general relativity, Einstein-Cartan, and higher derivative) are investigated. The qualitative properties of those curves by means of the introduction of an effective potential and then accomplish the analytical integration of the equations of motion are examined. It is shown that some of the qualitative features of the free motion in Godel's universe (I squared = 2 omega squared) are preserved in all space-times, namely the projections of the geodesics onto the 2-surface (r,psi) are simple closed curves, and the geodesics for which the ratio of asymuthal angular momentum to total energy, upsilon, is equal to zero, always cross the origin r = 0. However, two neq cases appear: radially unbounded geodesics with upsilon assuming any (real) value, which may occur only for the causal space-times (I squared is greater than or equal to 4 omega squared), and geodesics with upsilon bounded both below and above, which always occur for the circular family (I squared is less than 0) or space-times. DOE

N91-12169 Florida State Univ., Tallahassee.
CLOUD AND SURFACE CONTROL ON THE EARTH'S NET RADIATION BALANCE AND THE ROLE OF ATMOSPHERIC/OCEANIC ENERGY TRANSPORTS: A

SATELLITE PERSPECTIVE Ph.D. Thesis
Byung-Ju Sohn 1990 201 p
Avail: Univ. Microfilms Order No. DA9027804

The two dimensional 5 year mean energy transport potential function, based on the Nimbus-7 ERB (Earth Radiation Budget) measurements, shows an east-west coupled dipole structure in which North Africa is the major energy sink and the western Pacific is the major energy source. In conjunction with the dipole, the cross-meridional transports are up to 30 percent of the tropical north-south transports. This is the main justification for the importance of the east-west energy transport. The separation of the required energy transport into oceanic and atmospheric components based on the maximum entropy production reveals that cross-meridional energy transports in the oceanic areas are mainly achieved by the ocean fluid. Cloud-radiation feedback shows that cloud-induced long wave warming (cloud greenhouse influence) is dominant over the tropics whereas cloud-induced short wave cooling (cloud albedo influence) is dominant in the mid- and high-latitudes. These differential distributions result in a global net cloud cooling effect of -2.1 W m(exp -2). Dissert. Abstr.

N91-12170 Texas A&M Univ., College Station.
THE INITIATION AND TERMINATION OF PERSISTENT ATMOSPHERIC PHENOMENA IN A LOW-ORDER SPECTRAL MODEL Ph.D. Thesis
Laura Scott Kennedy 1990 133 p
Avail: Univ. Microfilms Order No. DA9027233

Regime behavior is investigated in a highly-truncated baroclinic spectral model with topography, frictional dissipation, and Newtonian cooling. Regimes are defined as the restriction of solution trajectories to isolated regions of phase space. 'Trough regime' initiation is characterized by the retrogression of the largest scale wave into its preferred location upstream of the orographic ridge during periods of weak zonal winds. Prior to regime initiation, the wave typically amplifies, often due to topographic instability. Regime termination normally occurs as a synoptic-scale wave amplifies. Wave-wave interaction between the synoptic-scale and the large-scale wave is a requirement for regime termination; if this interaction is removed, regime transitions do not occur. Thus regime behavior, in this simple model, is understood in terms of pure Rossby wave dynamics, modified preferentially by ambient conditions. Large orographic scale waves entering the regime domain encounter weak westerlies permitting slow retrogression and weak baroclinicity, implying persistence much more frequently than would be expected by chance; no other features occur persistently with regime transition. Dissert. Abstr.

N91-12171# Institute for Defense Analyses, Alexandria, VA.
PHYSICS OF HIGH-TEMPERATURE AIR. PART 1: BASICS Final Report, Oct. 1987 - Dec. 1988
Ernest Bauer May 1990 118 p
(AD-A224584; AD-E501257; IDA-D-487-Pt-1; IDA/HQ-88-33544-Pt-1) Avail: NTIS HC/MF A06 CSCL 20/13

This document provides an introduction for the non-specialist to the physics of dissociating and ionizing air in the temperature range from 1000 to 12,000 K. Topics addressed include the equilibrium composition and radiative properties of air under these conditions together with an indication of when and how the assumptions of equilibrium tend to break down. A preliminary discussion is given of applications to missile reentry, to nuclear fireballs, and to the physics of the upper atmosphere. GRA

N91-12172# Boston Univ., MA. Center for Space Physics.
THE EFFECTS OF MAGNETIC STORM PHASES ON F-LAYER IRREGULARITIES FROM AURORAL TO EQUATORIAL LATITUDES Quarterly Report, 1 Apr. - 30 Jun. 1990
Jules Aarons and Michael Mendillo 30 Jun. 1990 4 p
(Contract N00014-89-J-1754)
(AD-A225045) Avail: NTIS HC/MF A01 CSCL 04/1

In progress is a major study of the effect of the ring current on the sub-auroral and equatorial generation of patches of irregularities. In addition studies are on-going for determining the dynamics of electric field penetration in latitude with the start of a major geomagnetic storm. For the first time simultaneous observations of irregularities at high and equatorial latitudes were utilized. The studies use scintillation and spread F data as well as optical observations for data from 1971 to 1989. Two basic concepts are being studied. With the statistics of morphology of F-layer irregularities now in hand, it is possible to forecast in broad terms what to expect at equatorial, auroral and polar latitudes during various levels of solar flux. With the beginning of an understanding of the effect of the various phases of magnetic storms on generating irregularities as noted from the solar wind, ring current, convection, auroral index, and magnetic index parameters, it is possible to roughly forecast levels of F-layer irregularity intensity. With these in hand, the utility of space, time, and frequency diversity can be evaluated. Diversity could be used if forecasting in real time was possible. GRA

N91-12173# BBN Systems and Technologies Corp., Canoga Park, CA.
STUDY TO DETERMINE SEISMIC RESPONSE OF SONIC BOOM-COUPLED RAYLEIGH WAVES Final Report, 6 Nov. 1989 - 26 Apr. 1990
Mark R. Legg and Jerold M. Haber May 1990 50 p
(Contract F33615-86-C-0530)
(AD-A225105; HSD-TP-90-026) Avail: NTIS HC/MF A03 CSCL 08/11

A literature search was performed regarding the seismic effects of sonic booms with emphasis on the coupled Rayleigh wave resonance phenomenon. The literature search covered 3 primary sources of information: (1) Air Force Environmental Impact Assessment Documents, (2) litigation and claims, and (3) open scientific literature. The literature regarding sonic boom structural damage was reviewed under Task Order 0010. The investigations of seismic waves induced by sonic booms found the amplitudes of the ground motion insufficient to damage structures. Few instances were reported, however, where the actual resonant conditions of the sonic boom-coupled Rayleigh wave were observed. The ground motion amplification accompanying the resonance documented in these cases did not reach damaging levels. Nevertheless, it is theoretically possible that conditions exist which could result in damaging levels of ground shaking. In order to define under what specific conditions, if any, such resonance could occur, an additional literature review was conducted. GRA

N91-12174# Bonn Univ. (Germany, F.R.). Inst. fuer Physik.
SUDDEN SODIUM LAYERS IN POLAR LATITUDES, BETWEEN 90 AND 110 km ALTITUDE Thesis [PLOETZLICHE NATRIUMSCHICHTEN IN POLAREN BREITEN IM HOEHENBEREICH 90-110 KM]
Georg Hansen Jan. 1990 208 p In GERMAN; ENGLISH summary
(Grant DFG-Ho-858/1-5)
(Bonn-IR-90-03; ISSN-0172-8741; ETN-90-97873) Avail: NTIS HC/MF A10

A special feature of the atmospheric sodium layer, the so called Sudden Sodium Layers (SSL), which were observed with an Na lidar instrument at Andenes, Norway is studied. SSL occurs if, in a narrow altitude range (typically less than 2 km) the NA density increases over the normal Na density by a factor of at least 2, within 5 minutes. The SSL observed have the following properties: they develop between 90 and 100 km altitude; they develop between 20 and 02 LT; their appearance shows a strong positive correlation with that of f-type sporadic E layers; their appearance does not show a strong correlation with either riometer absorption or meteor showers; the temporal and spatial structures reveal a significant but complicated influence of wave activity. Potential SSL formation processes are discussed, including the meteor-tide-mechanism, the dust aurora mechanism, the Na+ conversion mechanism, the gravity wave mechanism, and a potential influence of Na chemistry. ESA

N91-12175# Bonn Univ. (Germany, F.R.). Inst. fuer Physik.
THE CABANNES-LIDAR FOR THE EXAMINATION OF THE STRATOSPHERE: THE BEAM PATH OF THE RECEIVING BRANCH Thesis [DES CABANNES-LIDAR ZUR UNTERSUCHUNG DER STRATOSPHAERE: DER STRAHLEGANG DES EMPFANGSZWEIGS]
Patrick Scheuch Jun. 1990 139 p In GERMAN; ENGLISH summary
(Bonn-IR-90-20; ISSN-0172-8741; ETN-90-97905) Avail: NTIS HC/MF A07

A lidar experiment under construction which measures temperature and aerosol content in the arctic stratosphere is addressed. Light pulses emitted by a laser and backscattered in the atmosphere are to be spectrally analyzed in the receiving branch with a Fabry Perot interferometer. The required band pass constrains the maximum permitted divergence of rays in the receiver and requires a careful estimate of the effect by all optical elements. A ray tracing program was used to calculate location and divergence of the beam passing through the optical elements of the receiver. Spots of the laserbeam in 8, 13, and 60 km altitude were selected as sources for modeling the beam path. Position, angle of incidence, and refractive or reflection properties of all optical elements were optimized with respect to temperature measurements in the ozone layer and the physical space available in the observatory building for placing the receiver bench. ESA

N91-12176# Technische Univ., Delft (Netherlands). Faculty of Geodesy.
GRAVITY RECOVERY FROM SATELLITE GRADIOMETRY Thesis
D. Stelpstra Apr. 1990 75 p
(ETN-90-98140) Avail: NTIS HC/MF A04

In satellite gradiometry the second order derivatives of the Earth's potential with respect to coordinates are measured. A set of simulated observations is used to perform a high degree and order global spherical harmonic analysis. The observations are preprocessed by averaging to form a constant radius, equiangular grid. Several more advanced procedures for obtaining such a grid are evaluated, but not used in the final adjustment. The observation equations and the normal equations are derived. By using the orthogonality relations of (co)-sine series and the symmetry of the grid it is shown the normal matrix is block structured. This can be effectively solved by Choleski decomposition. This algorithm was implemented on a CONVEX vector processor. The procedure gives good recovery of gravity for high degree and order global spherical harmonic analysis, although some not yet explained effects occur. ESA

N91-12177# Technische Univ., Delft (Netherlands). Faculty of Geodesy.
GRAVITY MEASUREMENT, PROCESSING AND EVALUATION: TEST CASES DE PEEL AND SOUTH LIMBURG Thesis
Ron Nohlmans May 1990 69 p
(ETN-90-98142) Avail: NTIS HC/MF A04

A general overview of the process of the measurement and the adjustment of a gravity network and the computation of some output parameters of gravimetry, gravity values, gravity anomalies and mean block anomalies, is given. An overview of developments in gravimetry, globally and in the Netherlands, until now is given. The basic theory of relative gravity measurements is studied and a description of the most commonly used instrument, the LaCoste and Romberg gravimeter is given. The surveys done in the scope of this study are descibed. A more detailed impression of the adjustment procedure and the results of the adjustment are given. A closer look is taken at the more geophysical side of gravimetry: gravity reduction, the computation of anomalies and the correlation with elevation. The interpolation of gravity and the covariance of gravity anomalies are addressed. ESA

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N91-12178 Wyoming Univ., Laramie.
MEASUREMENT OF SULFUR DIOXIDE REACTION RATES IN WINTERTIME OROGRAPHIC CLOUDS Ph.D. Thesis
Jefferson Robert Snider 1989 365 p
Avail: Univ. Microfilms Order No. DA9016668

Releases of SO2 into the wintertime orographic clouds at Elk Mountain in southeastern Wyoming were utilized to accelerate the rate of SO2 oxidation to cloud-water dissolved sulfate (SO4(-2)). Background SO2 mixing ratios were 0.6 parts-per-billion by volume (ppbv) and were consistent with the remote location of the experimental site and with supplemental cloud water, snow, and aerosol composition measurements. Background mixing ratios of hydrogen peroxide (H2O2) and the organohydroperoxides, expressed as methyl hydroperoxide (MHP), were 0.15 and 0.17 ppbv, respectively. The concentration of H2O2 in cloud water, obtained as rime, was also monitored. Analysis of these findings suggests that both reactive loss of H2O2 and volatilization during riming are mechanisms for H2O2 loss. The pseudo first-order SO2 depletion rates varied oetween 2 and 72 percent /hr (x=32 plus or minus 22 percent/hr, n=10). Observed depletions of H2O2 (x=0.030 ppbv) were consistent with observed yields of SO4(-2) (x=0.027 ppbv) and with model predictions. Observed depletions of MHP were not significantly different from 0.0 ppbv. This observation is both consistent with the much smaller solubility of MHP, compared with H2O2, and with the results of 16 model simulations. Reactions between dissolved SO2 and O3, between SO2 and O2, and between SO2 and HCHO were calculated to contribute less than 40 percent to the total amount of SO4(-2). These reactions were inferred to be inhibited by the low pH (less than 5) of the Elk Mountain cloud water. It is concluded that H2O2 is the dominant SO2 oxidant in these clouds, and that the laboratory measurements form an adequate basis for predicting the rate of in-cloud oxidation of SO2 by H2O2. Dissert. Abstr.

N91-12179 East Anglia Univ., Norwich (England).
COMPOSITION OF ATMOSPHERIC AEROSOLS IN RURAL EAST ANGLIA AND METEOROLOGICAL CONTROLS Ph.D. Thesis
Raad Rashad Yaaqub 1989 347 p
Avail: Univ. Microfilms Order No. BRDX88936

Daily samples of atmospheric aerosol were collected by high volume sampler on Whatman 41 filters at a coastal site in south east England for one year. Elemental analysis was undertaken by atomic absorption spectrophotometry for trace elements and by ion chromatography for nitrate, sulfate and chloride. Reflectometry was used to analyze carbon soot. The concentration of the analyzed elements and species were used to assess their mean concentration, their variability and the controlling factors. By using iron as the normalizing element and calculating enrichment factors, it is shown that the main components of the aerosol are crustal, marine and anthropogenic. Using a classification based on air mass trajectories (at 850mb and 700mb), wind fields, and weather types, it is shown that concentrations are highest in air arriving at the site from the east, in particular from Eastern Europe. Both this information and the principle component analysis results lead to the conclusion that the major factors controlling concentrations are meteorological. Aerosol samples collected on nucleopore filters were used for individual particle analysis. The analysis was performed by scanning electron microscopy interfaced with an energy dispersive x ray analyzer (EDAX), for shape, size distribution, elemental composition, and semi-quantitatively for elemental concentration. The results provide basic information on the physical and chemical properties of the aerosol as well as on their source. The results are consistent with those obtained from the atomic absorption spectrophotometry (AAS) bulk analysis.
Dissert. Abstr.

N91-12180 Wyoming Univ., Laramie.
A NUMERICAL STUDY OF PRECIPITATION PROCESSES IN

STABLE OROGRAPHIC STORMS Ph.D. Thesis
Larry David Oolman 1989 147 p
Avail: Univ. Microfilms Order No. DA9016666

A numerical model was developed to retrieve the microphysical and precipitation process of clouds utilizing the kinematic fields obtained from Doppler radar. This model uses parameterized bulk microphysics in which the water condensate is divided into three classes: cloud water, rain, and snow. The model was applied to a deep, stable orographic storm over the Sierra Nevada. The simulations indicated that these storms precipitate with a 90 percent efficiency. The time scale for a parcel to traverse the barrier is sufficiently long for precipitation processes to be effective. Modifying parameters in the model merely shifts the relative importance of various processes and has little effect on the precipitation efficiency. Only by shortening the parcel transit time, such as by increasing the wind velocity, does the precipitation efficiency decrease. The predicted ice particle spectra from the model agree quite well with the actual spectra from the Wyoming King Air aircraft through most of the interior of the cloud. The spectra does not agree as well near the cloud edges.
Dissert. Abstr.

N91-12181# Chicago Univ., IL. Dept. of Geophysical Sciences.
CYCLONES AND CYCLOGENESIS OVER NORTH PACIFIC, NORTH ATLANTIC, ARCTIC OCEAN, AND THEIR UPWIND CONTINENTS Final Report
T. Theodore Fujita 8 Jul. 1990 10 p
(Contract N00014-84-C-0513)
(AD-A225168) Avail: NTIS HC/MF A02 CSCL 04/2

For determining seasonal and annual variations of cyclone activities in the Northern Hemisphere, over 500 cyclones in National Meteorological Center (NMC) and Japanese surface maps were examined and their 6-hourly parameters were determined for generating the Northern Hemisphere Cyclone Tape. The cyclone tape, covering a five year period, June 1981 to May 1986 was generated under this contract. Produced from this tape are five Volumes of annual reports showing monthly, seasonal, and annual distributions of cyclone parameters depicted by red-colored cyclone parameters superimposed upon green-colored base maps. GRA

N91-12182# European Space Agency, Paris (France). Directorate of Observation of the Earth and its Environment.
BACKSCATTER LIDAR: THE POTENTIAL OF A SPACE-BORNE LIDAR FOR OPERATIONAL METEOROLOGY, CLIMATOLOGY AND ENVIRONMENTAL RESEARCH. REPORT TO THE ATLID CONSULTANCY GROUP
Colin Flood, Hartmut Grassl, Gerard Megie (Centre National de la Recherche Scientifique, Poitiers, France), and Duc. T. Guyenne, ed. May 1990 31 p Original contains color illustrations
(ESA-SP-1121; ISBN-92-9092-056-4; ETN-90-97992) Copyright
Avail: NTIS HC/MF A03; EPD, ESTEC, Noordwick, Netherlands, HC 30 Dutch guilders

An outline specification of a suitable spaceborne instrument to measure atmospheric parameters such as vertical temperature profiles, cloud cover and water vapor content was aimed for. ATLID (Atmospheric Lidar) which is a spaceborne backscatter lidar to be placed in a polar orbit, was studied. System capabilities, applications for ATLID, user requirements and their implications on system design are presented. Recommended actions from the main conclusion of high interest in meteorology, climatology, and environmental research are given. ESA

N91-12183# Naval Postgraduate School, Monterey, CA.
COMPARISON OF THE DYNAMICS OF A LAND VERSUS OCEANIC EXPLOSIVE CYCLONE M.S. Thesis
Michael E. Kreyenhagen Dec. 1989 72 p
(AD-A225529) Avail: NTIS HC/MF A04 CSCL 04/2

Two explosively developing cyclones are analyzed and compared using a similar diagnostic approach. A continental cyclone developed over the U.S. Mid-west during 14 to 17 November 1988 and was analyzed using NMC (Nested Grid model) analysis fields and GOES IR imagery. A maritime cyclone rapidly developed over the western North Atlantic Ocean during 3 to 5 January 1989. The NMC Spectral Model and GOES imagery are employed to describe the development of this storm. Upper-level vorticity, divergence and jet streak placement are examined along with low-level thermal advection, boundary layer heating and static stability for each storm. Results indicate that the land and ocean storms have similar magnitude upper-level divergence associated with 300 mb jet streaks, however, they evolve differently. At low-levels, there are equal contributions in the land case. The initial static stability was low for both cyclones, however, the ocean case maintained low static stability and this appears to be a major factor in determining the depth and speed of rapid cyclone developement. GRA

N91-11693*# New Hampshire Univ., Durham.
INFRARED THERMAL IMAGING OF ATMOSPHERIC TURBULENCE
David Watt and John McHugh *In* NASA, Langley Research Center, Airborne Wind Shear Detection and Warning Systems. Second Combined Manufacturers' and Technologists' Conference, Part 1 Jul. 1990 p 349-363 (For primary document see N91-11682 03-03)
Avail: NTIS HC/MF A15 CSCL 04B

N91-11769# Technische Univ., Delft (Netherlands).
MATHEMATICAL MODELLING OF FLIGHT IN TURBULENCE AND WINDSHEAR
M. Baarspul *In its* Essays on Stability and Control Oct. 1989 37 p (For primary document see N91-11759 03-09)
Avail: NTIS HC/MF A12

N91-11979*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
SITE COMPARISON FOR OPTICAL VISIBILITY STATISTICS IN SOUTHERN ARIZONA
K. A. Cowles *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 57-61 (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 04B

N91-12482*# Geological Survey, Lawrence, KS.
A SOLAR-LUMINOSITY MODEL AND CLIMATE
Charles A. Perry *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 181-188 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 04B

N91-12485*# Texas A&M Univ., College Station. Climate System Research Program.
CLIMATE FLUCTUATIONS AND CLIMATE SENSITIVITY
Gerald R. North and Kuor-Jier Joseph Yip *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 207-218 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 04B

N91-12486*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
FEEDBACK PROCESSES AND CLIMATE RESPONSE
Albert Arking *In its* Climate Impact of Solar Variability Aug. 1990 p 219-226 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 04B

N91-12490*# Texas Univ. at Dallas, Richardson. Center for Space Science.
FORCING OF CLIMATE VARIATIONS BY MeV-GeV PARTICLES
Brian A. Tinsley *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 249-258 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 04B

N91-12499*# National Science Foundation, Washington, DC. Div. of Atmospheric Sciences.
A REVIEW AND REFLECTIONS ON THE SUN-CLIMATE CONNECTION Abstract Only
Richard A. Goldberg *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 319 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 04B

N91-12504*# Academy of Sciences (USSR), Leningrad.
SOME RESULTS FROM STUDIES ON RELATIONSHIPS BETWEEN THE OPTICAL-METEOROLOGICAL PARAMETERS AND SOLAR ACTIVITY. PART 2: DEVELOPMENT OF THE PROBLEM OF SOLAR FORCING
K. Y. Kondratyev and G. A. Nikolsky (Leningrad State Univ., USSR) *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 351-353 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 04B

N91-12505*# Geological Survey, Lawrence, KS.
SPECULATION ON A SOLAR CHRONOMETER FOR CLIMATE
Charles A. Perry *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 357-364 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 04B

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N91-12184 Delaware Univ., Newark.
AN EMPIRICAL STUDY OF THE EFFECTS OF METEOROLOGIC AND TIDAL FORCING ON THE SEASONAL VERTICAL DENSITY STRUCTURE OF CHESAPEAKE BAY Ph.D. Thesis
James Tilton Smullen 1989 193 p
Avail: Univ. Microfilms Order No. DA9019302

A parametric, back-casting, predictive diagnostic tool for assessing the annual evolution of the vertical water column density stratification of the upper Chesapeake Bay is developed. The effects of tide, wind, fresh water inflow, and heat flux on the seasonal formation, intensity, duration, variability, and destruction of the water column density structure in the Chesapeake Bay are explored. An attempt is made to describe relationships between exogeneous variables: buoyancy fluxes (heat and fresh water) and turbulent kinetic energy (tides and wind); and the endogenous variable: a measure of stratification. The analytic approach is the statistical development of a one-dimensional (vertical), parametric representation of a potential energy balance equation for the estuarine water column in a time differential format. This equation is forward-integrated in time, and statistical estimators (coefficients of independent variables) are calculated using multiple regression analysis. Stratification is parameterized as a potential energy deficit, or anomaly; heat and fresh water inputs as buoyancy fluxes; and wind and tides as the rate of work done (or power expended) by the surface and bottom boundary stresses, respectively. Similar energy balance equations have been used for the analysis of frontal regions on continental shelves. An existing formulation from the literature is modified here for application to the estuary by adding terms to include buoyancy flux effects due to fresh water inflows from tributaries. Model results indicate that systematic, long-period variations (18 to 22 years) are present in annual series of stratification in the upper Chesapeake Bay. Dissert. Abstr.

N91-12185# Long Island Univ., Southampton, NY.
DOUBLE DIFFUSIVE INTERLEAVING ACROSS A THERMOHALINE FRONT Final Report
Eric S. Posmentier 30 May 1990 25 p
(Contract N00014-87-K-0390)
(AD-A224822) Avail: NTIS HC/MF A03 CSCL 08/3

A model of double diffusively driven interleaving layers across a thermohaline, barotropic front is developed. The mechanism of the interleaving was proposed by Stern (1967) for small perturbations of continuous, large scale T-S gradients in the saltfingering regime by double diffusive interleaving. The model shows that this mechanism is also effective for interleaving across an initially sharp front, after strong T-S inversions develop between intrusions, in regions in which the mean vertical gradients are in the saltfingering, diffusive, or doubly stable regimes. The vertical scale of the intrusions increases with increasing cross frontal T-S discontinuities, and decreases with increasing mean vertical density gradients. The cross frontal fluxes caused by the finescale interleaving can be substantial, and the vertical finescale fluxes can be up gradient. Sensitivity studies are performed to study the effects of the mean gradients, microscale flux parameters, and intrusion thickness and tilt on the interleaving T-S signature, velocity and length. GRA

N91-12186# Woods Hole Oceanographic Inst., MA.
THE 1989 SUMMER STUDY PROGRAM IN GEOPHYSICAL FLUID DYNAMICS: GENERAL CIRCULATION OF THE OCEANS
Barbara Ewing-DeRemer, ed. Nov. 1989 519 p Sponsored in part by ONR
(Grant NSF OCE-89-01012)
(AD-A225571; WHOI-89-54) Avail: NTIS HC/MF A22 CSCL 08/3

The following contents include: The General Circulation of The Oceans: The Basic Equations; Observations; Fundamental Large Scale Circulation Theories; Barotropic Vorticity Equation; The Effect of Inertia; Initiation of Sverdrup Flow; The General Circulation of the Oceans: Statistical One-layer Problems; Multi-layer and Continuously Stratified Quasi-geostrophic Wind Driven Flows; Parsons' Model applied to the Subpolar Gyre; and The Theory of the Ventilated Thermocline. GRA

N91-12187# Technische Univ., Delft (Netherlands). Faculty of Geodesy.
TIME-VARYING SEA SURFACE TOPOGRAPHY FROM ALTIMETRY: A STOCHASTIC APPROACH WITH REGARD TO GRAVITY COMPUTATIONS Thesis
N. J. Sneeuw Nov. 1989 88 p
(ETN-90-98145) Avail: NTIS HC/MF A05

An outline of probability theory is given and the theory is applied to the altimetric case, especially to the variable part of sea surface topography. Stochastic processes are analyzed and limitations met when testing for ergodicity are outlined. The findings are applied to the adjustment of repeated observations along collinear tracks. The transformation from geoid heights to gravity anomalies is addressed. Recommendations include that more attention should be paid to the deterministic modeling of time varying sea surface topography, i.e., the creation of sea level time series, since the conclusions on the stochastic approach are rather negative. ESA

N91-12487*# Florida State Univ., Tallahassee. Dept. of Meteorology.
ON THE DECADAL MODES OF OSCILLATION OF AN IDEALIZED OCEAN-ATMOSPHERE SYSTEM
Vikram M. Mehta *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 227-234 (For primary document see N91-12456 03-92)
(Contract DE-FC05-85ER-25000; NSF ATM-87-14674)
Avail: NTIS HC/MF A16 CSCL 08C

51 LIFE SCIENCES (GENERAL)

No abstracts in this category.

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N91-12188# Army Research Inst. of Environmental Medicine, Natick, MA. Exercise Physiology Div.
ASSESSMENT OF BODY WEIGHT STANDARDS IN MALE AND FEMALE ARMY RECRUITS Final Technical Report, Jun. 1988 - Dec. 1989
Karl E. Friedl, James A. Vogel, Matthew W. Bovee, and Bruce H. Jones 29 Dec. 1989 95 p
(DA Proj. 3E1-62787-A-879)
(AD-A224586; ARIEM-T15-90) Avail: NTIS HC/MF A05 CSCL 06/4

Army enlisted candidates are screened for obesity with height-weight tables (AR 40-501) which exclude few young males but approximately one third of young females in the U.S. population. Another regulation (AR 600-9) sets standards for retention in the Army on the basis of body fat estimated from circumferences. The suitability of accession weight standards with respect to the retention standards was examined by studying the effect of excess fatness on attrition from active duty, physical performance, and ability to achieve fat standards after basic training. GRA

N91-12189# Kentucky Univ., Lexington.
A NORMATIVE DATA STUDY OF ISOMETRIC NECK STRENGTH IN HEALTHY, ADULT MALES, AGES 18-35 M.S. Thesis
Julie Riedel Keller 1990 105 p Sponsored by AFIT, Wright-Patterson AFB, OH
(AD-A224642; AFIT/CI/CIA-90-063) Avail: NTIS HC/MF A06 CSCL 06/4

Isometric neck muscle contraction forces generated during attempted neck flexion, extension, and side bending by sixty subjects were measured using a load cell in order to establish normal ranges for cervical muscle strength. Contraction forces during three trials were collected and measured using ASYST 2.01. Time averaged forces and instantaneous peak forces generated were compared and no significant differences were evident. Measured mean extension forces (236 N) exceeded mean flexion forces (202 N) and mean side bending forces (155 N). Anthropometric measurements correlated poorly with measured cervical forces and are not recommended as cervical strength predictors. Correlations between dominant grip strength and neck strength were sought but no relationship was apparent. Force variability between trials was evaluated with analysis of variance testing, with significance set at p is less than 0.05. Increased forces were generated by successive contractions. Comparisons between right and left lateral neck strength indicated no statistically significant functional asymmetry between the two sides. Six subjects (10 percent) were randomly selected to return for repeat testing to evaluate test-retest reliability using paired t-tests, and no consistent differences between tests were evident. GRA

N91-12190# Florida State Univ., Tallahassee. Dept. of Psychology.
DETECTING TARGET WORDS WHILE MONITORING MULTIPLE AUDITORY INPUTS M.S. Thesis
John M. Barker, Jr. 1990 38 p Sponsored by AFIT, Wright-Patterson AFB, OH
(AD-A224687; AFIT/CI/CIA-90-060) Avail: NTIS HC/MF A03 CSCL 06/4

How can humans best detect an auditory input while monitoring several inputs simultaneously is examined. Two separate experiments were conducted, using a divided attention paradigm, to determine what factors influence target word detectability. Results from both experiments show an advantage in target detection if a person listens to one input in one ear and the other in the other ear (stereo) versus listening to both inputs in both ears (mono). Target detection was unaffected by variations in presentation rate in the range of 0.5 to 1.5 seconds. In the second experiment number of voices was examined as a factor. When both inputs were presented to each ear (mono) there was a clear advantage when listening to inputs that were recorded using two different voices (female and male) versus using only one voice (male only). However, the addition of a second voice did not improve target detection in the stereo condition. This latter finding may represent a limit on the effects of channel separation in target detection situations. Both a recency and primacy effect in terms of target detection as a function of the targets serial position in the list was found in both experiments. Results of these experiments have direct implications for practical applications, such as communication systems used by airline pilots. GRA

N91-12191# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
AN EXTENSION OF THE KREMERS/VAN NORREN MODEL FOR RETINAL LIGHT DAMAGE AND CONSEQUENCES THEREOF FOR OCCUPATIONAL SAFETY Final Report
J. J. Vos 15 Mar. 1990 33 p
(AD-A224879; IZF-1990-A-16; TDCK-90-0031) Avail: NTIS HC/MF A03 CSCL 06/4

The Kremers/Van Norren model gives a comprehensive across species description of retinal light damage threshold as a function of exposure time. It is based upon the assumptions that absorption in pigments in retina and pigment epithelium produces a toxic agent; that at sub-bleaching light levels the main mediating pigment is rhodopsin; and that at supra-bleaching level other pigments, possibly rhodopsin bleach products, take over. In the first part, the validity is verified of a few silent assumptions in the Kremers/Van Norren model: the neglection of the dynamic nature of the bleach process; the assumption that it is the maximum concentration of the toxic agent that determines the degree of damage; and the assumption that there is no cumulative effect of residual damage. The first assumption proved to be entirely justified. The second one not, but the mathematics of the original Kremers/Van Norren description remain valid when their 3.5 x 10(5) time constant is applied to the repair process, rather than to the toxic agent removal. As to the last assumption, the consequences of a cumulative residual damage mechanism are quantified. In the second part, consequences were drawn for practice. This is done in two ways. In the first place the results of the model computations were converted to convential Threshold Limit Values (TLVs) to make them comparable to current safety standards. It is shown that, on the basis of the model interpretation, these need considerable revision in the long term exposure domain. GRA

N91-12192# Dayton Univ., OH. Research Inst.
EFFICIENT IMAGE GENERATION USING LOCALIZED FREQUENCY COMPONENTS MATCHED TO HUMAN VISION Final Technical Report, Oct. 1987 - Feb. 1990
George A. Geri, Yehoshua Y. Zeevi, and Moshe Porat (Technion - Israel Inst. of Tech., Haifa.) Jul. 1990 66 p
(Contract F33615-87-C-0012; AF Proj. 1121; AF Proj. 2313)
(AD-A224903; AFHRL-TR-90-25) Avail: NTIS HC/MF A04 CSCL 12/5

Following a brief tutorial in the general area of image analysis, a formalism is presented for using the generalized Gabor approach to image representation in the combined frequency-position space. This approach uses elementary functions to which the human visual system is particularly sensitive and which are efficient for the analysis and synthesis of visual imagery. Among the topics covered are the complementarity of position and spatial frequency in the Gabor scheme, and the use of an auxiliary function to render the nonorthogonal Gabor elementary functions transformable. The

formalism is in particular compatible with the implementation of a variable resolution system wherein image information is nonuniformity distributed across the visual field in accordance with the human visual system's ability to process it. A possible hardware implementation of such a system is described and some potential problems associated with its development are discussed.
Author (GRA)

N91-12193# Illinois Univ., Urbana-Champaign. Aviation Research Lab.
THE EFFECTS OF ATROPINE SULFATE ON AVIATOR PERFORMANCE Final Report, 15 May 1983 - 14 Sep. 1984
Henry L. Taylor, John A. Dellinger, Bruce C. Richardson, Martha H. Weller, Stephen W. Porges, Christopher D. Wickens, James E. LeGrand, and John M. Davis Sep. 1989 78 p
(Contract DAMD17-83-C-3150; DA Proj. 3M4-63764-D-995)
(AD-A224916; ARL-TR-85-1; USAARL-CR-89-9) Avail: NTIS HC/MF A05 CSCL 06/5

The purpose of the present study was to determine the effect of atropine sulfate on pilot performance, as measured in a flight simulator, and to investigate physiological correlates of this effect. The six dependent measures of flying the simulator using standard instrument procedures indicated the significant effects of atropine was found between the 0.5 and the 4.0 mg levels atropine. The most significant effect was to the 4.0 mg level. For the Sternberg secondary task, reaction time and accuracy showed no atropine effects. Mean heart period (MHP), heart period variance (HPV), showed the effects of atropine sulfate and the time course of the effect. It was concluded that the 4.0 mg level of atropine produced significant performance decrements and increased the risk of error when performing complex pilot tasks. The performance effects were found to lag behind the physiological effects. GRA

N91-12194# Northwestern Univ., Evanston, IL.
THE 1988 ANTHROPOMETRIC SURVEY OF US ARMY PERSONNEL: CORRELATION COEFFICIENTS AND REGRESSION EQUATIONS. PART 1: STATISTICAL TECHNIQUES, LANDMARK, AND MEASUREMENT DEFINITIONS Final Report, 1 Apr. 1989 - 31 Mar. 1990
James Cheverud, Claire C. Gordon, Robert A. Walker (Army Natick Research and Development Command, MA.), Cashell Jacquish, Luci Kohn, Allen Moore, and Nyuta Yamashita May 1990 76 p
(Contract DAAK60-89-C-1006)
(AD-A224986; NATICK-TR-90/032-Pt-1) Avail: NTIS HC/MF A05 CSCL 05/9

This five-part series of reports tabulates the statistical relationships among anthropometric measurements so that designers of Army materiel systems will be able to utilize the data in improving the man-materiel interface. The kinds of statistical relationships tabulated include simple correlations, partial correlations, bivariate regressions and multiple regressions. The simple correlations, partial correlations, and bivariate regressions are among all pairs of characters. Four sets of partial correlations are included, partialling out: stature only; weight only; stature and weight simultaneously; and stature, weight, and age simultaneously. Standard multiple regressions include specific anthropometric dimensions regressed on standard pairs of measurements. Stepwise multiple regressions were also calculated for each anthropometric dimension using the first five independent variables selected in the stepwise procedure. All analyses were performed separately for males and females and are reported separately in the tables. GRA

N91-12195# Ohio Wesleyan Univ., Delaware. Vision Lab.
ANALYSIS OF RETINAL FUNCTION FOLLOWING LASER IRRADIATION Midterm Technical Report, 30 Oct. 1987 - 29 Oct. 1989
David O. Robbins May 1990 25 p
(Contract DAMD17-88-C-8032; DA Proj. 3E1-62787-A-878)
(AD-A225021) Avail: NTIS HC/MF A03 CSCL 06/5

Exposure of the foveal to a single or multiple pulses of coherent light produce both transient and permanent changes in the eye's ability to resolve fine spatial detail. The immediate effects are often large, reflecting a total loss of foveal functioning although, depending upon exposure conditions, are reversible. Permanent functional changes in achromatic and chromatic acuity can occur in the absence of gross morphological damage and at power densities below the ED50 level provided the area of involvement is large. At power densities above the ED50 level, little if any permanent and consistent deficits in visual performance are noted if the damage is restricted to relatively isolated areas of either the fovea or parafovea. GRA

N91-12196# Anthropology Research Project, Yellow Springs, OH.
THE 1988 ANTHROPOMETRIC SURVEY OF US ARMY PERSONNEL: METHODS AND SUMMARY STATISTICS Final Report, 1 Oct. 1988 - 24 Mar. 1989
Claire C. Gordon, Thomas Churchill, Charles E. Clauser, Bruce Bradtmiller, John T. McConville, Ilse Tebbetts, and Robert A. Walker (Army Natick Labs., MA.) Sep. 1989 651 p
(Contract DAAK60-86-C-0128)
(AD-A225094; NATICK-TR-89/044) Avail: NTIS HC/MF A99 CSCL 05/9

Results of the 1987 to 1988 anthropometric survey of Army personnel are presented in this report in the form of summary statistics, percentile data and frequency distribution. These anthropometric data are presented for a subset of personnel (1774 men and 2208 women) sampled to match the proportions of age categories and racial/ethnic groups found in the active duty Army of June 1988. Dimensions given in this report include 132 standard measurements made in the course of the survey, 60 derived dimensions calculated largely by adding and subtracting standard measurement data, and 48 head and face dimensions reported in traditional linear terms but collected by means of an automated headboard designed to obtain three-dimensional data. Measurement descriptions, visual indices, and a glossary of terms are included to help identify and locate dimensions. Descriptions of the procedures and techniques used in this survey are also provided. These include explanations of the complex sampling plan, computer editing procedures, and strategies for minimizing observer error. Tabular material in appendices are designed to help users understand various practical applications of the dimensional data, and to identify comparable data obtained in previous anthropometric surveys. GRA

N91-12197# Oregon Univ., Eugene. Dept. of Computer Science.
STEREOPSIS AND THE COMBINATION OF SURFACE CUES Final Report
Kent A. Stevens and Jacob Beck 10 Jul. 1990 73 p
(Contract N00014-87-K-0321)
(AD-A225109) Avail: NTIS HC/MF A04 CSCL 06/4

This report describes research regarding the integration of spatial information. Part 1 (Stevens) reports work that addresses questions of integration, including the form of the spatial information provided by human stereopsis towards the perception of visual surfaces and the strategies by which this information is reconciled with monocular 3D information. Part 2 (Beck) concerns how surface orientation and distance are perceived in wire-frame figures that are projected orthographically. GRA

N91-12198# Texas A&M Univ., College Station. Hyperbaric Lab.
THE EFFECT OF HEATING ON TENDON AND JOINT BLOOD FLOW Final Report, Aug. 1987 - Jan. 1989
William P. Fife Jun. 1990 28 p
(Contract F33615-87-C-0604)
(AD-A225233; USAFSAM-TR-89-13) Avail: NTIS HC/MF A03 CSCL 06/10

Current decompression sickness prevention techniques which offer only limited or intermittent perfusion of tight connective tissues is the suspected reason for long nitrogen washout times. If this is the case, whether heat applied to bends-susceptible joints may increase perfusion and decrease washout times is investigated. A laser Doppler probe was used to evaluate perfusion in Achilles

tendons of 20 pigs, 5 dogs, and 4 goats. Baseline measurements were taken with motionless animals. Heating was then applied and resulting measurements were compared. Earlier observations that tendon blood flow shut down for extended period of time was not confirmed. In this study, there was a constant, but low perfusion of the tendons and joint capsules in all three species tested and perfusion appeared to be uniform throughout each tendon or capsule. Local heating elevated the perfusion by as much as 300 percent in some animals, although the elevation was not consistent or statistically significant since the laser beam observed a volume of approximately 1 cu mm, and at no time was there zero flow. It appears that even if there was local shutdown of perfusion in a small area adjacent to the one being observed, the perfusion in adjacent areas (within 1 mm) is sufficient to prevent supersaturation with inert gas and hence the formation of bubbles in these tissues. GRA

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N91-12199*# Lockheed Space Operations Co., Cocoa Beach, FL.
REMOTE VOICE TRAINING: A CASE STUDY ON SPACE SHUTTLE APPLICATIONS, APPENDIX C
Cindy Mollakarimi and Tamin Hamid 1990 10 p
(Contract NCC10-001)
(NASA-CR-187385; NAS 1.26:187385) Avail: NTIS HC/MF A02 CSCL 05I

The Tile Automation System includes applications of automation and robotics technology to all aspects of the Shuttle tile processing and inspection system. An integrated set of rapid prototyping testbeds was developed which include speech recognition and synthesis, laser imaging systems, distributed Ada programming environments, distributed relational data base architectures, distributed computer network architectures, multi-media workbenches, and human factors considerations. Remote voice training in the Tile Automation System is discussed. The user is prompted over a headset by synthesized speech for the training sequences. The voice recognition units and the voice output units are remote from the user and are connected by Ethernet to the main computer system. A supervisory channel is used to monitor the training sequences. Discussions include the training approaches as well as the human factors problems and solutions for this system utilizing remote training techniques. Author

N91-12200# Tennessee Univ., Knoxville. Dept. of Psychology.
VALIDITY MEASURES IN THE CONTEXT OF LATENT TRAIT MODELS Technical Report, 1987 - 1990
Fumiko Samejima 15 Jun. 1990 25 p
(Contract N00014-87-K-0320; NR Proj. RR0-4204)
(AD-A224695; ONR-RR-90-3) Avail: NTIS HC/MF A03 CSCL 12/3

In contrast to the progressive desolution of the reliability coefficient in classical mental test theory and the replacement by the test information function in latent trait models, the issue of test validity has been more or less neglected in modern mental test theory. Some considerations are provided about the validity of a test and of a single item. Effort has been focused upon searching for measures which are population-free, and which will provide us with local and abundant information just as the information functions do in comparison with the test reliability coefficient in classical mental test theory. In so doing, validity indices for different purposes of testing and also those which are tailored for a specific population of examinees are considered. GRA

N91-12201# Tennessee Univ., Knoxville. Dept. of Psychology.
PREDICTIONS OF RELIABILITY COEFFICIENTS AND STANDARD ERRORS OF MEASUREMENT USING THE TEST INFORMATION FUNCTION AND ITS MODIFICATIONS Technical Report, 1987 - 1990
Fumiko Samejima 30 Jun. 1990 27 p
(Contract N00014-87-K-0320; NR Proj. RR0-4204)
(AD-A224696; ONR-RR-90-2) Avail: NTIS HC/MF A03 CSCL 05/8

There seems to be a concensus that two main measures in classical mental test theory are the reliability and validity coefficients of a test. Although these measures have widely been accepted by psychologists and test users in the past decades, they are actually the attributes of a specified group of examinees as well as of a given test, since the correlation coefficient is used in either case. In addition, representation of these measures by single numbers results in over simplification and the lack of useful information for both theorists and actual users of tests. The same applies for the standard error of measurement also. In latent trait models, the item and test information functions provide us with abundant information about the local accuracy of estimation, a concept which is totally missing in classical mental test theory. These functions do not depend upon any specific group of examinees as the reliability coefficient does, or it can be said that they are population-free. By virtue of this characteristic, adding further information about the MLE bias function of the test and the ability distribution of the examinee group, the tailored reliability coefficient and standard error of measurement can be provided in the classical mental test theory's sense for each and every specified group of examinees who have taken the same test. GRA

N91-12202# Naval Postgraduate School, Monterey, CA.
AN ANALYSIS OF THE EFFECT OF FREQUENCY OF TASK PERFORMANCE ON JOB PERFORMANCE MEASUREMENT M.S. Thesis
Rick L. Reece Mar. 1990 69 p
(AD-A225304) Avail: NTIS HC/MF A04 CSCL 05/9

The effect is explored of frequency of performance on the Congressionally mandated Job Performance Measurement, specifically the Marine Corps' portion of the study. The initial portion of the project involved the hands-on performance testing of the infantry specialities. The use is validated of the general technical (GT) composite of the Armed Services Vocational Aptitude Battery (ASVAB) test as a predictor of performance in the infantry specialty and to provide recommendations to revise training priorities. The approach in analyzing the problem included the following: (1) computing the correlation between aptitude and performance, then investigating any degrading or moderating effect that frequency might have on this relationship; (2) an investigation into the performance of high aptitude personnel versus low aptitude personnel across frequency categories; and (3) the relative effect of frequency on the maintenance of proficiency in each task. The use was validated of the GT composite as an effective predictor for hands on performance by performing analysis of variance. An interesting result was the determination that frequency is the major predictor for performance based tasks requiring continual practice for the maintenance of skill levels, while recency is the major factor in predicting tasks that are more knowledge based and require the recall of detailed procedures. GRA

N91-12203# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
LIMITS OF PRECISION FOR HUMAN EYE MOTOR CONTROL
Manfred Fahle Nov. 1989 22 p Prepared in cooperation with the Center for Biological Information Processing, Whitaker College
(Contract N00014-85-K-0124)
(AD-A225515; AI-M-1209; CBIP-48) Avail: NTIS HC/MF A03 CSCL 06/4

If the two segments of a vernier target are presented to different eyes (dichoptically, thresholds are three to four times higher than with presentation to the same eye), the increase in thresholds is

mainly due to uncorrelated movements of both eyes, such as tremor and drifts, that occur even under steady fixation. The psychophysically measured thresholds allow one to calculate an upper estimate for the amplitudes of uncorrelated eye movements during fixation. This estimate matches the best results from direct eye position recording, with the calculated mean amplitude of eye tremor corresponding to roughly one photo-receptor-diameter. The combined amplitude of both correlated and uncorrelated eye movements was also measured by delaying one segment of the vernier relative to its partner under monocular or dichoptic conditions. Fixation proved to be relatively stable, and trained observers could sustain eye position within a few arcmin. GRA

N91-12204# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Psychology.
QUALITATIVE REASONING: HOW WE THINK OUR WAY THROUGH THE DAY
Herbert A. Simon 1 Mar. 1990 17 p Prepared in cooperation with Pittsburgh Univ., PA
(Contracts N00014-86-K-00678; F33615-84-K-1520)
(AD-A225646; AIP-130) Avail: NTIS HC/MF A03 CSCL 05/8

We have come full circle back to the topic of visualization and the role of the mind's eye and of external visual displays in human thinking. I have tried to survey some of the main tools and processes that seem to be implicated in everyday reasoning -- the kind that carries us through the day, dealing with problems as they arise. The thinking I have described does not look at all like formal logic, and only a little like mathematics. It makes use of a great multitude of inference rules, which are not tautological rules of logic but incorporate much real-world knowledge. It appears to be remarkably unconcerned with questions of sufficiency and necessity. When it deals with quantities, as if often must, it usually handles primarily their ordinal rather than their cardinal properties. For most people, at least, it makes great use of diagrammatic representations, or mental diagrams in the mind's eye, which provide it with powerful inference processes. To compensate for its severe limitations in handling simultaneous relations, it proceeds by successive approximations, and halts when it has satisfied. By the standards of formal logic, it is a jerry-built structure. But it gets us through the day. GRA

N91-11760# Technische Univ., Delft (Netherlands).
DEVELOPMENTS IN MATHEMATICAL MODELS OF HUMAN PILOT BEHAVIOR
O. H. Gerlach *In its* Essays on Stability and Control Oct. 1989 27 p (For primary document see N91-11759 03-09)
Avail: NTIS HC/MF A12

N91-11766# Technische Univ., Delft (Netherlands).
VISUAL-VESTIBULAR INTERACTION IN PILOT'S PERCEPTION OF AIRCRAFT OR SIMULATOR MOTION
R. J. A. W. Hosman and J. C. vanderVaart *In its* Essays on Stability and Control Oct. 1989 24 p (For primary document see N91-11759 03-09)
Avail: NTIS HC/MF A12

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N91-12205# Oak Ridge National Lab., TN. Cognitive Systems and Human Factors Group.
THE PART TASK TRAINER FOR AIRBORNE WEAPONS SYSTEMS: HUMAN FACTORS EVALUATION OF THE USER INTERFACE
Michele Terranova and Diane E. Hartley (Tennessee Univ., Knoxville.) Sep. 1990 66 p
(Contracts DE-AC05-84OR-21400; DOE-1714-1714-A1)
(DE90-017772; ORNL/TM-11635) Avail: NTIS HC/MF A04

This research examined and evaluated the human factors aspects of a part-task trainer's user interface. Questionnaires, interviews, and observational techniques were used. A number of established human factors attributes were investigated such as user control and trainer fidelity. Recommendations are given for a variety of issues such as screen design (e.g., design log-on process and procedures for user identification to be as simple as possible); text display (e.g., avoid sentences exceeding 20 words); and training for cognitive skills (e.g., train time sharing skills for dealing with high workload environments). The results and recommendations for future enhancements are reported. An installation process was documented and comments regarding its effectiveness are included. DOE

N91-12206# Anacapa Sciences, Inc., Fort Rucker, AL.
AN EXPERIMENTAL EVALUATION OF THE CUEING PROCEDURES USED WITH THE PILOT'S LINE-OF-SIGHT RETICLE Interim Report, Feb. 1987 - Dec. 1989
Richard D. Weeter and D. Michael McAnulty Jun. 1990 46 p
(Contract MDA903-87-C-0523)
(AD-A224935; ASI690-316-90; ARI-RN-90-28) Avail: NTIS HC/MF A03 CSCL 05/8

Three experiments were conducted to evaluate the cueing procedure for the copilot-gunner's (CPG) line-of-sight (LOS) symbol in the AH-64A pilot night vision system. The location of the CPG, or Cued, LOS is indicated by dots positioned on imaginary axes extending from the arms (0, 90, 180, 270 deg) of the pilot's LOS reticle. The procedure uses either one- two-dot cues to indicate one of eight search areas for locating the CPG LOS. The cueing dots also flash when the pilot must boresight the integrated helmet and display sight subsystem (IHADSS). The three experiments used a selective visual attention paradigm. Experiment 1 evaluated the effects of the number of cueing elements and the presentation duration on the accurate perception of the cues. Experiment 2 compared the effectiveness of the one-and two-dot cues in locating a fixed target. Experiment 2 also evaluated the effects of presentation duration and practice on target identification accuracy. Experiment 3 evaluated the effect of the secondary meaning (boresight required) on the accuracy of target identification under the dot, duration, and practice conditions. GRA

N91-12207# Air Force Human Resources Lab., Brooks AFB, TX. Logistics and Human Factors Div.
DESIGNING HUMAN-CENTERED SYSTEMS: CIRCA 2039 SCENARIO Interim Technical Report, Aug. 1988 - Apr. 1990
Eugene H. Henry Aug. 1990 13 p
(AD-A225075; AFHRL-TR-90-32) Avail: NTIS HC/MF A03 CSCL 12/5

The advancement of technology has permitted the introduction of automation into a variety of military environments. Though automation offers new and increased capabilities, issues exist concerning the operability of systems with automation. For example, what is the appropriate operator workload associated with using automated systems. To answer such questions, a new and broad methodology is required. The Air Force Human Resources Laboratory (AFHRL) is presently conducting research to develop such a methodology, called the Automation Impacts Research Testbed (AIRT). A futuristic vision of a mature AIRT is provided along with how it can assist the design of automated systems. In relating this vision, the report is written as a story set in the twenty-first century. The story illustrates the operability concept through characters who describe examples of good and bad operability designs. Additionally, the story includes a description of possible tools that might be used in the future to address operability concerns. The scenario ends by being linked to the research presently being conducted at AFHRL. GRA

N91-12208# Dynamics Research Corp., Wilmington, MA.
HARDWARE VERSUS MANPOWER COMPATIBILITY METHODOLOGY. VOLUME 1: OVERVIEW AND MANAGER'S GUIDE Final Report, Sep. 1986 - Mar. 1988

David Herlihy, Jane Bondaruk, Guy Nicholas, Robert Guptill, and John Park May 1990 163 p
(Contract MDA903-86-C-0298; DA Proj. 2Q2-63007-A-793)
(AD-A225122; ARI-RP-90-19A-Vol-1) Avail: NTIS HC/MF A08
CSCL 05/9

The Army Hardware vs. Manpower (HARDMAN) Comparability Methodology (HCM) is a six-step process for determining a weapon system's manpower, personnel, and training (MPT) requirements. It provides a structured approach for early MPT estimation based on comparability analysis, an analytic system that uses knowledge about similar existing systems and technological growth trends to project the MPT requirements of proposed new systems. The HCM's six interrelated steps are Systems Analysis, Manpower Requirements Analysis, Personnel Pipeline Analysis, Training Resource Requirements Analysis, Impact Analysis, and Tradeoff Analysis. The HCM has been successfully applied to a range of weapons systems, including air, armor, artillery, infantry, air defense, command and control, and intelligence systems. The Product Improvement Program for HCM made major revisions to the existing HCM Guide. The scope has been expanded to include several new areas; existing procedures have been revised, refined, and clarified; and the entire Guide has been rewritten to achieve greater clarity, consistency, and completeness. This volume addresses the planning and conducting of an HCM analysis. Procedures are provided for determining the analysis scope and estimating the resources required for the analysis. Preparation of the quality assurance plan and establishment of the consolidated database are explained. The relationship between HCM results and various Army MPT documents is also discussed. GRA

N91-12209# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
TEMPORAL ISSUES OF ANIMATE RESPONSE
A. A. M. Kuijk Dec. 1989 14 p
(CWI-CS-R8960; ETN-90-98093) Copyright Avail: NTIS HC/MF A03

Due to increased capacities of personal workstations, graphical user interfaces become capable of offering natural human computer interaction. This results in animate response, i.e., natural transitions from one state into another. It is recognized that for optimal efficiency, such animate response should be tuned to the time frame of the user. It is not sufficient to speed up the response as much as possible: the temporal characterisics of the response should be based on human perceptual capabilities. A survey of notions related to animate response is presented. Subjects which need consideration and/or further investigation are addressed throughout. ESA

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N91-12210*# Search Technology, Inc., Norcross, GA.
ASSESSING THE IMPACT OF MODELING LIMITS ON INTELLIGENT SYSTEMS Final Report
William B. Rouse and John M. Hammer Washington NASA Nov. 1990 52 p
(Contract NAS1-19021)
(NASA-CR-4336; NAS 1.26:4336) Avail: NTIS HC/MF A04
CSCL 12A

The knowledge bases underlying intelligent systems are validated. A general conceptual framework is provided for considering the roles in intelligent systems of models of physical, behavioral, and operational phenomena. A methodology is described for identifying limits in particular intelligent systems, and the use of the methodology is illustrated via an experimental evaluation of the pilot-vehicle interface within the Pilot's Associate. The requirements and functionality are outlined for a computer based knowledge engineering environment which would embody the approach advocated and illustrated in earlier discussions. Issues considered include the specific benefits of this functionality, the potential breadth of applicability, and technical feasibility. Author

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N91-12211# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
CISLAN ARCHITECTURE: FIRST CYCLE
A. Pras and I. G. Niemegeers Apr. 1990 15 p
(Memo-INF-90-19; ISSN-0923-1714; ETN-90-98121) Avail: NTIS HC/MF A03

The distributed architecture for a future local integrated communication infrastructure is presented. This infrastructure avoids central components, such as traditional PABXs (Private Automatic Branch Exchange) as much as possible and is based on existing and emerging standards. To investigate such an infrastructure, a research project CISLAN was started. The project aims at the definition of the architecture, and the implementation of key elements thereof. An approach rather than a specific solution is discussed with focus on the distributed CISLAN architecture. This architecture is developed in a cyclic fashion and recognizes three different reference models: functional, configuration and implementation. ESA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N91-12212# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
MINIMUM COST ROUTES CALCULATION BY MEANS OF DIGITAL ELEVATION MODELS
Ewerton SantosSilva and Luiz Alberto VieiraDias Mar. 1990 10 p Presented at the International Society of Photogrammetry and Remote Sensing (ISPRS), Tsukuba, Japan, 15-18 May 1990 Submitted for publication
(INPE-5040-PRE/1573) Avail: NTIS HC/MF A02

The calculation of minimum energy cost routes based on data extracted from a Digital Elevation Model (DEM) is examined. The cost is a function of the terrain slope, and path distance. In order to keep the computer (IBM-PC-XT-like) time within reasonable limits, instead of a real terrain, it was used as a synthetic model. On a personal workstation a larger set of data can be used. As conclusion it was seen that it is possible to use personal computers for these time consuming calculations, and graphically display the results. Author

N91-12213# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
THE INTEGRATION OF TERMINOLOGICAL AND LOGICAL KNOWLEDGE REPRESENTATION LANGUAGES

Guilherme Bittencourt Jun. 1990 18 p Presented at the 5th International Symposium on Methodologies for Intelligent Systems, Knoxville, TN, 24-27 Oct. 1990 Submitted for publication
(INPE-5092-PRE/1597) Avail: NTIS HC/MF A03

The syntax and semantics is described of two knowledge representation languages: A first-order logic language and a terminological language. The adopted first-order logic language allows the calculation of a decidable entailment relation between logic formulas, and the terminological language provides the efficient calculation of subsumption between concept and relation descriptions. A hybrid inference mechanism is defined that takes into account the knowledge represented in logical and in terminological form. The semantics of both languages and of the hybrid inference mechanism is defined in a four-valued logic framework. The resulting inference algorithm is sound and complete with respect to the adopted four-valued semantics and also computationally tractable. Author

N91-12214# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
THE 0-1 MULTIKNAPSACK PROBLEM: MONOTONE SURROGATE AND LAGRANGEAN ALGORITHMS
Luiz Antonio NogueiraLorena and G. Plateau (Paris VIII Univ., Villetaneuse, France) Feb. 1990 29 p Presented at the International Conference on Operations Research, Vienna, Austria, 28-31 Aug. 1990 Submitted for publication
(INPE-5036-PRE/1571) Avail: NTIS HC/MF A03

An approach for generating monotone decreasing algorithms to the 0-1 Multiknapsack surrogate and Lagrangean relaxations is shown. The work is centralized in controlling the step size of a subgradient type algorithm. A repetition of optimal intermediate values for the surrogate algorithm is avoided at least at the third consecutive iteration, and for the Lagrangean case a monotone decreasing sequence of values is assured. A lot of computational tests with problems of the literature are presented. Author

N91-12215*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SHARED DIRECT MEMORY ACCESS ON THE EXPLORER 2-LX
Jeffrey L. Musgrave Sep. 1990 46 p
(NASA-TM-103289; E-5747; NAS 1.15:103289) Avail: NTIS HC/MF A03 CSCL 09B

Advances in Expert System technology and Artificial Intelligence have provided a framework for applying automated Intelligence to the solution of problems which were generally perceived as intractable using more classical approaches. As a result, hybrid architectures and parallel processing capability have become more common in computing environments. The Texas Instruments Explorer II-LX is an example of a machine which combines a symbolic processing environment, and a computationally oriented environment in a single chassis for integrated problem solutions. This user's manual is an attempt to make these capabilities more accessible to a wider range of engineers and programmers with problems well suited to solution in such an environment. Author

N91-12216*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
COMPILING GLOBAL NAME-SPACE PROGRAMS FOR DISTRIBUTED EXECUTION Final Report
Charles Koelbel (Purdue Univ., West Lafayette, IN.) and Piyush Mehrotra Oct. 1990 37 p Submitted for publication
(Contracts NAS1-18605; N00014-88-M-0108)
(NASA-CR-187454; NAS 1.26:187454; ICASE-90-70) Avail: NTIS HC/MF A03 CSCL 09B

Distributed memory machines do not provide hardware support for a global address space. Thus programmers are forced to partition the data across the memories of the architecture and use explicit message passing to communicate data between processors. The compiler support required to allow programmers to express their algorithms using a global name-space is examined. A general method is presented for analysis of a high level source program and along with its translation to a set of independently executing tasks communicating via messages. If the compiler has enough information, this translation can be carried out at compile-time. Otherwise run-time code is generated to implement the required data movement. The analysis required in both situations is described and the performance of the generated code on the Intel iPSC/2 is presented. Author

N91-12217*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
PROGRAMMING DISTRIBUTED MEMORY ARCHITECTURES USING KALI Final Report
Piyush Mehrotra (Purdue Univ., West Lafayette, IN.) and John VanRosendale Oct. 1990 24 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187453; NAS 1.26:187453; ICASE-90-69) Avail: NTIS HC/MF A03 CSCL 09B

Programming nonshared memory systems is more difficult than programming shared memory systems, in part because of the relatively low level of current programming environments for such machines. A new programming environment is presented, Kali, which provides a global name space and allows direct access to remote data values. In order to retain efficiency, Kali provides a system on annotations, allowing the user to control those aspects of the program critical to performance, such as data distribution and load balancing. The primitives and constructs provided by the language is described, and some of the issues raised in translating a Kali program for execution on distributed memory systems are also discussed. Author

N91-12218# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
RECEPTION AND DISPLAY OF WEFAX IMAGES: 4 BITS WITH MICRO LINE IBM-PC-OPERATING MANUAL [RECEPCAO E VISUALIZACAO DE IMAGENS WEFAX: 4 BITS COM MICROS LINHA IBM-PC-MANUAL DO OPERADOR]
Sofia Sundfeld Nov. 1989 29 p In PORTUGUESE; ENGLISH summary
(INPE-5085-NTE/293) Avail: NTIS HC/MF A03

Routine procedures are presented for the WEX 3.0 system of reception and display of WEFAX low resolution meteorological satellite images. Reception is made with microcomputers of the IBM-PC type with a 4.77 MHz clock through a four bit analog-digital conversion interface fed by the demodulated and amplified satellite signal. Image display is made with four or eight optional colors on a color video monitor. Image printing has seven gray levels and is made on dot matrix printers. Two and four times enlargements of image sectors are also possible. Full images need 256 kbytes of memory and enlargements 32 kbytes; both are compressed when recorded in disks. Author

N91-12219# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
FUNDAMENTALS OF NUMERICAL ANALYSIS FOR DIGITAL COMPUTERS, VOLUME 2 [FUNDAMENTOS DE ANALISE NUMERICA PARA COMPUTADORES DIGITAIS, VOLUME 2]
C. J. Zamlutti Apr. 1990 182 p In PORTUGUESE; ENGLISH summary
(INPE-5088-MD/043-Vol-2) Avail: NTIS HC/MF A09

Under the denomination of direct methods, a set of methods are collected in a same context for the theory of approximations. The set is characterized by the possibility of obtaining, a-priori, the amount of work required for a derived accuracy. In the methods presented, the quality can be determined directly by the approximated error limits. This volume presents the first chapters of the third part of the work Analise de Metodos Numericos (Analysis of Numerical Methods). Author

N91-12220*# Hawaii Univ., Manoa. Dept. of Electrical Engineering.
ON COMPLEXITY OF TRELLIS STRUCTURE OF LINEAR BLOCK CODES
Shu Lin 15 Oct. 1990 38 p

(Grant NAG5-931)
(NASA-CR-187397; NAS 1.26:187397; NASA-90-004) Avail: NTIS HC/MF A03 CSCL 09B

The trellis structure of linear block codes (LBCs) is discussed. The state and branch complexities of a trellis diagram (TD) for a LBC is investigated. The TD with the minimum number of states is said to be minimal. The branch complexity of a minimal TD for a LBC is expressed in terms of the dimensions of specific subcodes of the given code. Then upper and lower bounds are derived on the number of states of a minimal TD for a LBC, and it is shown that a cyclic (or shortened cyclic) code is the worst in terms of the state complexity among the LBCs of the same length and dimension. Furthermore, it is shown that the structural complexity of a minimal TD for a LBC depends on the order of its bit positions. This fact suggests that an appropriate permutation of the bit positions of a code may result in an equivalent code with a much simpler minimal TD. Boolean polynomial representation of codewords of a LBC is also considered. This representation helps in study of the trellis structure of the code. Boolean polynomial representation of a code is applied to construct its minimal TD. Particularly, the construction of minimal trellises for Reed-Muller codes and the extended and permuted binary primitive BCH codes which contain Reed-Muller as subcodes is emphasized. Finally, the structural complexity of minimal trellises for the extended and permuted, and double-error-correcting BCH codes is analyzed and presented. It is shown that these codes have relatively simple trellis structure and hence can be decoded with the Viterbi decoding algorithm. Author

N91-12221# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
REPRESENTATION AND MANIPULATION OF GRAPHIC IMAGES UTILIZING QUATERNARY TREES M.S. Thesis - 12 Sep. 1989 [REPRESENTACAO E MANIPULACAO DE IMAGENS GRAFICAS UTILIZANDO ARVORES QUATERNARIAS]
Joao Pedro CerveiraCordeiro Apr. 1990 78 p In PORTUGUESE; ENGLISH summary
(INPE-5069-TDL/408) Avail: NTIS HC/MF A05

Conversion between representations, neighbor finding, and set operations are basic tasks for systems that deal with graphic images in several research and application areas. This work focuses on the implementation of some procedures for neighbor finding, basic set operations of union and intersection, rotation by right angles, involving images represented by quadtrees, as well as the generation of a quadtree structure from the matrix, raster, and vector format. The task of obtaining a raster image from its quadtree is also implemented. Some aspects of the classical and linear quadtree structure are considered. Author

N91-12222# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
TEXTUAL LINGUISTICS AND KNOWLEDGE REPRESENTATION: A HIGHLIGHT [LINGUISTICA TEXTUAL E REPRESENTACAO DO CONHECIMENTO: UM ENFOQUE]
Carlos A. deOliveira May 1990 24 p In PORTUGUESE; ENGLISH summary Presented at the Conference on Assembly Linguistics of State Linguistics (GEL)/89, Lorena, Brazil
(INPE-5064-PRE/1590) Avail: NTIS HC/MF A03

A possible link is discussed between text linguistics and natural language processing: the knowledge representation problems studies. Author

N91-12223# Montana State Univ., Bozeman. Dept. of Chemistry.
APPLICATION OF COMPUTERS FOR EXPERIMENT DESIGN, DATA ACQUISITION, AND ANALYSIS IN THE CHEMISTRY LABORATORY Ph.D. Thesis
Ronald Paul Furstenau May 1990 262 p Sponsored by AFIT, Wright-Patterson AFB, OH
(AD-A224644; AFIT/CI/CIA-90-15D) Avail: NTIS HC/MF A12 CSCL 07/4

The objective was to develop an introductory chemistry program which uses computers in the laboratory for experiment design, data acquisition, and data analysis. The project used the Montana State University (MSU) laboratory interface system. The system is an integrated hardware and software package which allows for a wide variety of measurements (pH, temperature, time, voltage, current, etc.) totally under the control of the user. The MSU lab interface system was designed to allow students to participate in the process of science. The hardware and software contain components which allow students to design experiments, acquire data in methods which they choose, and organize and analyze the data to draw conclusions. To meet the objective, the following was developed and accomplished: (1) a model which explains how computers in the laboratory can improve a student's overall understanding of chemistry and laboratories; (2) a laboratory program which successfully taught students how to use the MSU laboratory interface system to design their own experiments; and (3) experiments designed to utilize the capabilities of the MSU lab interface system. GRA

N91-12224# Arizona State Univ., Tempe.
AN EVALUATION OF A MODIFIED SIMULATED ANNEALING ALGORITHM FOR VARIOUS FORMULATIONS Ph.D. Thesis
James Scott Shedden Aug. 1990 207 p Sponsored by AFIT, Wright-Patterson AFB, OH
(AD-A224678; AFIT/CI/CIA-90-020D) Avail: NTIS HC/MF A10 CSCL 12/1

Many combinatorial optimization problems are too large to allow exact solution methods to give results in a reasonable amount of time. An alternative is the use of heuristics that sacrifice a degree of optimality in return for timelier solutions. One such heuristic, simulated annealing, is a form of iterative improvement that probabilistically accepts less optimal configurations. This procedure allows the algorithm to escape local minima (or maxima) in its search for a global minimum. This paper presents modified simulated annealing formulations of common industrial engineering problems. The modified algorithm behaves like a biased random walk that can be tailored to suit a user's particular bias set. Modifications to the standard application include: an expert system front end, a constraints module, a user interrupt capability, and the creation of alternative acceptance functions. GRA

N91-12225# Naval Research Lab., Washington, DC. Center for Computational Physics Development.
AN ALGORITHM FOR IMPROVED GATING COMBINATORICS IN MULTIPLE-TARGET TRACKING Interim Report
M. R. Zuniga, J. M. Picone, and J. K. Uhlmann 2 Aug. 1990 21 p
(Contract N00014-86-C-2197)
(AD-A224700; NRL-MR-6691) Avail: NTIS HC/MF A03 CSCL 17/11

A method is described for significantly reducing the computational complexity required for observations-track gating in multiple target tracking. The gating process is defined as follows: given a set of N(R) observations and N(T) tracks, identify all observation-track pairs whose scores fall above a chosen threshold. The score for observation-track pair (i,j) is defined as the function: In the analysis and numerical simulations we employ algorithms which find near neighbors of points in 1-D position space, where nearness is defined by the Euclidean metric. They are used, for example, to find the tracks with mean positions near a given observation position. It is essential that: these algorithms find all the neighbors in some expected optimal or near optimal time; and that their performance be relatively insensitive to spatial distributions. After examining several search algorithms, a BLD-enhanced k-d search tree was selected for the tests. GRA

N91-12226# California Univ., Los Angeles. Western Management Science Inst.
FW/SM: A PROTOTYPE STRUCTURED MODELING ENVIRONMENT
Arthur M. Geoffrion 25 May 1990 38 p Sponsored by NSF; ONR; Ketron, Inc.; and Shell Development Co.
(AD-A224756; WMSI-WORKING PAPER-377) Avail: NTIS HC/MF A03 CSCL 12/5

A research prototype implementation has been evolving for several years in parallel with the vision, theory, language, and applicative aspects of structured modeling. The capabilities of this implementation as it now stands are described, and comments are made on how it contributes toward fulfilling a previously published agenda for the development of a new generation of modeling environments. The intended audience is all modeling system designers and evaluators, including those who do not happen to take a structured modeling approach. GRA

N91-12227# Army Research Inst. for the Behavioral and Social Sciences, Alexandria, VA.
EXPERIMENTAL DEVELOPMENT OF TAXONOMIC WORKSTATION Final Report, 1 Oct. 1988 - 30 Sep. 1989
Don B. Headley 23 Feb. 1990 4 p
(DA Proj. 3M2-63003-D-995)
(AD-A224809) Avail: NTIS HC/MF A01 CSCL 12/5

The TWS software was reviewed and accepted by the Technical Monitor. At OMPAT's request, a second version of TWS was prepared. It is called the Non-DoD Version and omits the military task analysis files; this latter version will be sent to nongovernment users who do not have military contracts. The Technical Monitor distributed both TWS versions to the sponsors. The Technical Monitor created a TWS Quick Reference Guide, and completely rewrote the TWS User Guide which was initially delivered by the contractor. These draft materials were sent to the sponsors and to the contractor. The contractor provided a technical review of these two materials for ARI. GRA

N91-12228# Air Force Academy, CO. Dept. of Mathematical Sciences.
COMPUTER PROGRAMMING AND GROUP THEORY Final Report, Aug. 1989 - Jun. 1990
Michael K. Keane and David W. Jensen May 1990 158 p
(AD-A225155; USAFA-TR-90-4) Avail: NTIS HC/MF A08 CSCL 12/5

This report investigates the use of the personal computer as an aid in the study of Group Theory. Chapter 1 discusses the basic mathematical concepts used and how they are translated into a programming language. Chapter 2 describes testing results using the forty non-isomorphic groups of order three to sixteen. Chapter 3 builds upon the previous chapter, presenting several examples an instructor could use to focus and clarify the ideas presented in the class and text. GRA

N91-12229# Lawrence Livermore National Lab., CA.
REMAP: A COMPUTER CODE THAT TRANSFERS NODE INFORMATION BETWEEN DISSIMILAR GRIDS
Arthur N. Shapiro Apr. 1990 26 p
(Contract W-7405-eng-48)
(DE91-000073; UCRL-ID-104090) Avail: NTIS HC/MF A03

REMAP is a computer code that transfers the axisymmetric, two dimensional planar, or three dimensional temperature field from one finite element mesh to another. The meshes may be arbitrary as far as the number of elements and their geometry. REMAP interpolates or extrapolates the node temperatures from the old mesh to the new mesh using linear, bilinear, or trilinear isoparametric finite element shape functions. REMAP is used to transfer the temperature field from a thermal analysis mesh to a more finely discretized structural analysis mesh when performing a thermal stress analysis. REMAP was designed to be used with the finite element heat transfer codes TOPAZ2D and TOPAZ3D, and the solid mechanics codes NIKE2D and NIKE3D. The I/O formats in REMAP can be easily modified to accept input from other codes (e.g., finite difference) and generate output files for other structural codes. REMAP can be used to transfer any scalar field variable between dissimilar finite element meshes. The idea of a coarse filter by a fine filter to determine which element from the old mesh contains a node point from the new mesh was used. The coarse filter determines a subset of elements from the old mesh that may contain the new node point. The fine filter determines the element that contains the new node point. REMAP uses the ray surface intersection algorithm developed for the FACET code for the fine filter. This algorithm has the added capability to determine which element the node is closest to if the node point lies outside the perimeter of the old mesh. Once an element from the old mesh has been identified as containing or closest to the new node point, the natural coordinates for the node point are calculated. The isoparametric finite element shape functions are calculated next. These shape functions are then used to interpolate or extrapolate the temperatures from the nodes comprising the old element to the new node point. DOE

N91-12230# Geological Survey, Denver, CO.
FREQFIT: COMPUTER PROGRAM WHICH PERFORMS NUMERICAL REGRESSION AND STATISTICAL CHI-SQUARED GOODNESS OF FIT ANALYSIS
Gregg S. Hofland and Christopher C. Barton 1990 62 p
(Contract DE-AI08-78ET-44802)
(DE91-000133; USGS-OFR-89-139) Avail: NTIS HC/MF A04

The computer program FREQFIT is designed to perform regression and statistical chi-squared goodness of fit analysis on 1-D or 2-D data. The program features an interactive user dialogue, numerous help messages, an option for screen or line printer output, and the flexibility to use practically any commercially available graphics package to create plots of the program's results. FREQFIT is written in Microsoft QuickBASIC, for IBM-PC compatible computers. A listing of the QuickBASIC source code for the FREQFIT program, a user manual, and sample input data, output, and plots are included. DOE

N91-12231# Los Alamos National Lab., NM. Theoretical Div.
APPLICATIONS OF MAXENT TO QUANTUM MONTE CARLO
Richard N. Silver, Devinderjit S. Sivia, James E. Gubernatis, and Mark Jarrell (Ohio State Univ., Columbus.) 1990 16 p Presented at the MaxEnt 1990: Maximum Entropy Workshop, Laramie, WY, 30 Jul. - 3 Aug. 1990 Submitted for publication
(Contract W-7405-eng-36)
(DE91-000216; LA-UR-90-3249; CONF-9007172-2) Avail: NTIS HC/MF A03

The application is considered of maximum entropy methods to the analysis of data produced by computer simulations. The focus is the calculation of the dynamical properties of quantum many body systems by Monte Carlo methods, which is termed the Analytical Continuation Problem. For the Anderson model of dilute magnetic impurities in metals, spectral functions and transport coefficients are obtained which obey Kondo Universality. DOE

N91-12232# California Univ., Berkeley. Lawrence Berkeley Lab. Applied Science Div.
THE PRACTICAL COMPUTER IN DESIGN
Jennifer Schuman and Gregory Ward Jul. 1990 6 p Presented at the 5th International Conference on Systems Research, Informatics, and Cybernetics, Baden-Baden, Fed. Republic of Germany, 6-12 Aug. 1990 Submitted for publication
(Contract DE-AC03-76SF-00098)
(DE91-000353; LBL-29301; BS-276; CONF-9008156-1) Avail: NTIS HC/MF A02

Electronic information processing is becoming a necessity in today's complex design environment. The appropriate role for the computer in the design process is examined. Computation should be applied throughout all design phases, but practicing designers today rarely use computers beyond simple word processing and drafting tasks. While many design tasks are poorly matched to the computer, other pragmatic and productive avenues remain unexploited. We discuss the need to recognize which elements of the design process are most suited to computer assistance. The role of the computer is designed as an objective assistant to the designer, and practical approaches are discussed in two application areas for computers in design: design simulation and resource information management. DOE

N91-12233# Pacific Northwest Lab., Richland, WA.
EFFICIENT ITERATION IN DATA-PARALLEL PROGRAMS WITH IRREGULAR AND DYNAMICALLY DISTRIBUTED DATA STRUCTURES

Richard J. Littlefield Feb. 1990 15 p Presented at the 1990 International Conference on Parallel Processing, University Park, PA, 13-17 Aug. 1990
(Contract DE-AC06-76RL-01830; NSF CCR-86-19663; NSF CCR-98-07666)
(DE91-000417; PNL-SA-17937; CONF-900874-4) Avail: NTIS HC/MF A03

To implement an efficient data-parallel program on a non-shared memory MIMD multicomputer, data and computations must be properly partitioned to achieve good load balance and locality of reference. Programs with irregular data reference patterns often require irregular partitions. Although good partitions may be easy to determine, they can be difficult or impossible to implement in programming languages that provide only regular data distributions, such as blocked or cyclic arrays. Onyx, a programming system that provides a shared memory model of distributed data structures is being developed and extended to the concept of data distribution to include irregular and dynamic distributions. This provides a powerful means to specify irregular partitions. Perhaps surprisingly, programs using it can also execute efficiently. The Onyx implementation of a model problem that repeatedly executes an irregular but fixed data reference pattern is described and evaluated. On an NCUBE hypercube, the speed of the Onyx implementation is comparable to that of carefully handwritten message-passing code. DOE

N91-12234# Universiteit Twente, Enschede (Netherlands).
THREE-DIMENSIONAL BODY PARAMETER ESTIMATION FROM DIGITAL IMAGES Ph.D. Thesis
Maarten J. Korsten 1989 137 p
(ISBN-90-9002738-6; ETN-90-97761) Copyright Avail: NTIS HC/MF A07

Attention is given to some methods concerning the extraction of information from images with the help of computers. Elements of optimal estimation theory and modeling techniques were combined systematically to a method for the analysis of images. Motion is considered as a clue to obtain a shape estimation from. Shape from shading is added to the framework and both parameters are combined to obtain an optimal parameter estimate. Examples with the formulas, details and results are presented. ESA

N91-12235# Universiteit Twente, Enschede (Netherlands).
DATA AND KNOWLEDGE BASE MANAGEMENT SYSTEMS: DATA MODEL AND QUERY PROCESSING Ph.D. Thesis
Maurice Antonius Wil Houtsma 1989 207 p
(ISBN-90-9003107-3; ETN-90-97762) Copyright Avail: NTIS HC/MF A10

A semantic data model and recursive query processing for a Data and Knowledge Base Management System (DKBMS) are studied. A formalization of the constructs in the model and a way to translate applications specified in the model to a relational database schema are described. An extension to relational algebra that allows formulation of recursive queries is described and algebraic optimization of a class of recursive queries is discussed. A rewriting strategy which transforms recursive queries into standard relation algebra is developed with an extra operation called transitive closure. This allows the relational query optimizer to use its full scale of optimization strategies to come to an efficient schedule. Efficient algorithms for the computation of the transitive closure are developed. Distributive database systems are studied for use in this, allowing parallelism to speedup query processing. A speedup method called disconnection set an approach is developed. ESA

N91-12236# Universiteit Twente, Enschede (Netherlands).
THE USE OF FUNCTIONAL PROGRAMMING IN SOFTWARE DEVELOPMENT Ph.D. Thesis
Stephanus Maria Math Joosten 1989 145 p
(ISBN-90-9002729-7; ETN-90-97775) Copyright Avail: NTIS HC/MF A07

The application of functional programming in the process of developing software is studied. The application is enhanced by presentation of examples of real time applications and the description and demonstration of programming techniques. Programming techniques for algorithms in general and specialization to stream processing functions are discussed. Real time systems are considered a further specialization to stream processing. The applications include a computer graphics problem, goods flow in a hospital, a database prototype and a regular expression parser with attributes. The method of software development is illustrated by a small example, covering the entire method from specification to imperative realization. ESA

N91-12237# European Space Agency, Paris (France).
EQUATIONS OF MOTION OF MULTIBODY SYSTEMS IN THE ESA-MIDAS SOFTWARE
Duc Minh Tran (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) and C. Barron, ed. Jul. 1990 59 p
(ESA-STR-232; ISBN-92-9092-017-3; ISSN-0379-4067; ETN-90-97997) Copyright Avail: NTIS HC/MF A04

Two formalisms for deriving the equations of motion of multibody systems are presented. In the first formalism, Lagrange's equations are written for each isolated body. This results in the system of first order differential equations involving the whole set of generalized coordinates, completed by constraint equations. The constraint forces and torques are either computed at each integration step, or eliminated by performing the singular value decomposition of the constraint matrix. In the second formalism, based on Kane's method, all the locked degrees of freedom are eliminated, as well as the associated non working constraint forces and torques. This leads to a system of differential equations with minimum dimension. The remaining constraint forces and torques are eliminated by the QR decomposition technique. Both formalisms are implemted in the ESA-MIDAS software and are used to simulate the motion of a three link manipulator. The results from simulations compare closely with the theoretical results, and Kane's method is shown to be more efficient than Lagrange's formalism. ESA

N91-12238# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Analysis, Algebra and Geometry.
SYSTEMATIC COMPUTATIONS ON GAUSS' LATTICE POINT PROBLEM (IN COMMEMORATION OF JOHANNES GAULTHERUS VAN DER CORPUT, 1890-1975)
J. vanderLune and E. Wattel (Vrije Univ., Amsterdam, Netherlands) May 1990 29 p
(CWI-AM-R9008; ETN-90-98064) Copyright Avail: NTIS HC/MF A03

Fairly extensive numerical computations concerning the true size of the error in Gauss' lattice point problem are reported. The results led to the conjecture that error(t):= points(t)-pi t = theta(t to the 1/4 power log(t)). Calculations are given using an unsophisticated FORTRAN 2 program for computation. ESA

N91-12239# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
POLYNOMIAL-TIME ALGORITHMS FOR SINGLE-MACHINE MULTICRITERIA SCHEDULING
J. A. Hoogeveen and S. L. vandeVelde May 1990 16 p Submitted for publication
(CWI-BS-R9008; ETN-90-98072) Copyright Avail: NTIS HC/MF A03

The problem of scheduling n independent jobs on a single machine so as to minimize multiple criteria is addressed. Three types of problems are considered. The first one involves the minimization of an arbitrary nondecreasing function of total completion time and an arbitrary nondecreasing minmax cost function. An O(n cubed min(n,log n + log p(max))) time algorithm, where p(max) is the maximum job processing time is presented. The algorithm can be improved to run in O(n cubed) time for the special case that the second objective is the maximum lateness. The second problem is to minimize a nondecreasing linear function of total completion time and maximum earliness. This problem is proved to be solvable in O(n to the 4th power) time if the total

completion times outweighs the maximum earliness. The third problem involves the minimization of a nondecreasing linear function of maximum earliness and maximum lateness, where preemption is allowed. An O(n log n) time algorithm for this problem is presented. ESA

N91-12240# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
DUALITY-BASED ALGORITHMS FOR SCHEDULING UNRELATED PARALLEL MACHINES
S. L. vandeVelde May 1990 22 p Submitted for publication
(CWI-BS-R9010; ETN-90-98073) Copyright Avail: NTIS HC/MF A03

The following parallel machine scheduling problem is considered. Each of n independent jobs has to be scheduled on one of m unrelated parallel machines. The processing of job J(j) on machine M(i) requires a positive processing time P(ij). The objective is to find an assignment of jobs to machines so as to minimize the maximum job completion time. The design of practical algorithms for this NP hard problem is addressed. Optimization and approximation algorithms, in which the notion of duality plays a key role are presented. The optimization algorithm is capable of solving quite large problems within reasonable time limits. The approximation algorithm is based upon a novel concept for iterative local search, in which the search direction is guided by dual multipliers. ESA

N91-12241# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
ASYMPTOTIC PROPERTIES OF STATISTICAL MODELS IN SOFTWARE RELIABILITY
Mark C. vanPul May 1990 23 p
(CWI-BS-R9011; ETN-90-98074) Copyright Avail: NTIS HC/MF A03

In software reliability theory, many different models have been proposed and investigated. A number of important models are completely characterized by their intensity function. A rather general class of intensity functions is considered. Sufficient conditions are given under which some important asymptotic properties of the model and the maximum likelihood estimators for the model parameters can be proved. An application to software reliability theory is presented. ESA

N91-12242# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
AN ANALYSIS OF LOOP CHECKING MECHANISMS FOR LOGIC PROGRAMS
Roland N. Bol, Krzysztof R. Apt, and Jan Willem Klop Oct. 1989 59 p
(CWI-CS-R8942; ETN-90-98075) Copyright Avail: NTIS HC/MF A04

Loop checking mechanisms for logic programs are systematically studied by considering their soundness, completeness, relative strength and related concepts. A natural concept of a simple loop check is introduced and it is proved that no sound and complete simple loop check exists, even for programs without function symbols. A number of sound simple loop checks are introduced and natural classes of PROLOG programs without function symbols for which they are complete are identified. In these classes a limited form of recursion is allowed. As a byproduct, an implementation of the closed world assumption of Reiter and a query evaluation algorithm for these classes of logic programs are obtained. ESA

N91-12243# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
CONFLUENCE OF THE DISJOINT UNION OF CONDITIONAL TERM REWRITING SYSTEMS
Aart Middeldorp Oct. 1989 21 p Sponsored in part by EEC
(CWI-CS-R8944; ETN-90-98077) Copyright Avail: NTIS HC/MF A03

Toyoma proved that confluence is a modular property of term rewriting systems. This means that the disjoint union of two confluent term rewriting systems is again confluent. His result is extended to the class of conditional term rewriting systems. In view of the important role of conditional rewriting in equational logic programming, this result may be of relevance in integrating functional programming and logic programming. ESA

N91-12244# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
TRANSITION SYSTEM SPECIFICATIONS WITH NEGATIVE PREMISES
Jan Friso Groote Dec. 1989 29 p Sponsored in part by EEC
(CWI-CS-R8950; ETN-90-98083) Copyright Avail: NTIS HC/MF A03

The general approach to Plotkin style operational semantics is extended to Transition System Specifications (TSS's) with rules that may contain negative premises. Two problems arise: firstly the rules may be inconsistent, and secondly it is not obvious how a TSS determines a transition relation. A general method, based on the stratification technique in logic programming is presented to prove consistency of a set of rules and it is shown how a specific transition relation can be associated with a TSS in a natural way. A special format for the rules, the ntyft/ntyxt-format, is defined. It is shown that for this format three important theorems hold. The first theorem says that bisimulation is a congruence if all operators are defined using this format. The second theorem states that under certain restrictions a TSS in ntyft-format can be added conservatively to a TSS in pure ntyft/ntyxt-format. It is shown that the trace congruence for image finite processes induced by the pure ntyft/ntyxt-format is precisely bisimulation equivalence. ESA

N91-12245# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
SEMANTIC MODELS FOR A VERSION OF PARLOG
Frank S. deBoer, Joost N. Kok, Catuscia Palamidessi (Pisa Univ., Italy), and Jan J. M. M. Rutten Jan. 1989 33 p Sponsored in part by EEC
(CWI-CS-R8951; ETN-90-98084) Copyright Avail: NTIS HC/MF A03

Four semantics for PARLOG are given, two operational samantics based on a transition system, a declarative semantics, and a denotational semantics. One operational and the declarative semantics model the success set of a PARLOG program, that is, the set of computed answer substitutions corresponding to all successfully terminating computations. The other operational and the denotational semantics model also deadlock and infinite computations. For the declarative and the denotational semantics, standard notions like unification are extended in order to cope with the synchronization mechanism of PARLOG. The basic mathematical structure for the declarative semantics is the set of finite stream of substitutions. In the denotational semantics, tree-like structures that are labeled with streams of substitutions are used. The relations between the different models are examined: the two operational semantics are related and the relation of the declarative and denotational semantics with their operational counterparts is shown. ESA

N91-12246# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
CONTROL FLOW VERSUS LOGIC: A DENOTATIONAL AND A DECLARATIVE MODEL FOR GUARDED HORN CLAUSES
Frank S. deBoer, Joost N. Kok, Catuscia Palmidessi (Pisa Univ., Italy), and Jan J. M. M. Rutten Jan. 1989 19 p Sponsored in part by EEC
(CWI-CS-R8952; ETN-90-98085) Copyright Avail: NTIS HC/MF A03

Four semantic models for Guarded Horn Clauses (GHC) are given. Two operational models are based on a transition system; the first one gives the set of computed answer substitutions (the so-called success set) and the second one takes deadlock and infinite behavior into account. They are easily related. The main

purpose is to develop compositional models for GHC that correct with respect to the operational models. For the success set case, a compositional declarative semantics wich can be seen as an extension of models for Horn Clause Logic is given. A metric semantics that uses tree like structures is given, which is proved to be correct with respect to the second operational semantics. ESA

N91-12247# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
A PARALLEL OBJECT-ORIENTED LANGUAGE: DESIGN AND SEMANTIC FOUNDATIONS
P. H. M. America and J. J. M. M. Rutten (Philips International B.V., Eindhoven, Netherlands) Dec. 1989 47 p Repr. from Languages for Parallel Architectures: Design, Semantics, Implementation Models, Wiley Series in Parallel Computing (J. W. deBakker), 1989 p 1-49
(CWI-CS-R8953; ETN-90-98086) Copyright Avail: NTIS HC/MF A03

The language POOL2 integrates the structuring mechanisms of object oriented programming. The most important issues in the design of this language are discussed. In particular, an overview of the basic principles of objected oriented programming is given and several different ways of combining them with parallellism are compared. The language is illustrated by a programming example. Two kinds of formal semantics are defined: an operational semantics based on transition systems and a denotational semantics, which uses the framework of complete metric spaces. These two semantic models are found to be equivalent, in the sense that the operational semantics of a program can be recovered from its denotational semantics by applying an abstraction operation. The semantic techniques are introduced by applying them first to a simplified language. ESA

N91-12248# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
CONCURRENCY SEMANTICS BASED ON METRIC DOMAIN EQUATIONS
J. W. deBakker and J. J. M. M. Rutten Dec. 1989 29 p
(CWI-CS-R8954; ETN-90-98087) Copyright Avail: NTIS HC/MF A03

The solution of domain equations in the category of complete metric spaces is shown. For five example languages the exploitation of domain equations in the design of their operational and denotational semantics is demonstrated. Two languages are schematic or uniform. Three have interpreted elementary actions involving individual variables and inducing state transformations. For the latter group, three denotational models reflecting a variety in the language notions considered are discussed. A central theme is the distinction, within the nonuniform setting, of linear time versus branching time models. Throughout, fruitful use is made of the technique of obtaining semantic mappings, operators etc. as fixed points of higher order functions. The relationship between bisimulation and one of the domains considered is discussed. ESA

N91-12249# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
USING TRANSFORMATIONS TO VERIFY PARALLEL PROGRAMS
Ernst-Ruediger Olderog (Oldenburg Univ., Germany, F.R.) and Krzysztof R. Apt Dec. 1989 30 p
(CWI-CS-R8956; ETN-90-98089) Copyright Avail: NTIS HC/MF A03

An argument that the verification of parallel programs can be considerably simplified by using program transformations is presented. This approach is illustrated by proving correctness of two parallel programs under the assumption of fairness: asynchronous fixed point computation and parallel zero search. ESA

N91-12250# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
STRONG COMPLETENESS FOR HOARE LOGICS OF RECURSIVE PROCESSES: AN INFINITY APPROACH
Alban Ponse and Fer-Jan deVries Dec. 1989 39 p
(CWI-CS-R8957; ETN-90-98090) Copyright Avail: NTIS HC/MF A03

A study is presented to abstract from datatypes and set up Hoare logics for partial correctness for process languages based on process algebra. These process languages cover features of programming languages unrelated to program variables and data types: sequential composition, non deterministic choise, tests, conditionals, iterations and recursion. Both logics are complete for different classes of recursive processes (respectively processes wich define a regular or a context-free language). The strong completeness theorems for the Hoare logics follow from the completeness theorem for assertion logic and the theorem stating that assertion logic is a conservative extension of both Hoare logics. The strong completeness theorems imply the usual relative completeness (in the sense of Cook) theorems. As a corollary, relative completeness theorems for the Hoare logic imperative (non)deterministic programming languages are obtained. Another corollary is that the semantics induced by the Hoare logics can now be axiomatized in the style of process algebra. ESA

N91-12251# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
WHICH DATA TYPES HAVE OMEGA-COMPLETE INITIAL ALGEBRA SPECIFICATIONS
J. A. Bergstra (Amsterdam Univ., Netherlands) and J. Heering Dec. 1989 19 p Submitted for publication Sponsored in part by EEC
(CWI-CS-R8958; ETN-90-98091) Copyright Avail: NTIS HC/MF A03

An algebraic specification is called omega-complete or inductively complete if all (open as well as closed) equations valid in its initial model are equationally derivable from it, i.e., if the equational theory of the initial model is identical to the equational theory of the specification. As the latter is recursively enumerable, the initial model of an omega-complete algebraic specification is a data type with a recursively enumerable equational theory. It is shown that if hidden sorts and functions are allowed in the specification, the converse is also true: every data type with a recursively enumerable equational theory has an omega-complete initial algebra specification with hidden sorts and functions. It is shown that in the case of finite data types the hidden sorts can be dispensed with. ESA

N91-12252# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
TERMINATION OF DISJOINT UNIONS OF CONDITIONAL TERM REWRITING SYSTEMS
Aart Middeldorp Dec. 1989 27 p Sponsored in part by EEC
(CWI-CS-R8959; ETN-90-98092) Copyright Avail: NTIS HC/MF A03

Several results concerning the termination of the disjoint union of term rewriting systems to conditional term rewriting systems are extended. The first termination property studied is strong normalization (there are no infinite reduction sequences) and it is shown that sufficient conditions for the strong normalization of the disjoint union of two strongly normalizing term rewriting systems given by Rusinowitch and Middeldorp extend naturally to conditional term rewriting systems. Weak normalization is not preserved under disjoint unions. This is rather surprising because the disjoint union of weakly normalizing unconditional term rewriting systems is weakly normalizing. Besides giving sufficient conditions for the weak normalization of disjoint unions of weakly normalizing conditional term rewriting systems, a much simpler proof of a recent approach to weak normalization due to Kurihara and Kaji is given. ESA

N91-12253# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
UNIQUE NORMAL FORMS FOR DISJOINT UNIONS OF CONDITIONAL TERM REWRITING SYSTEMS
Aart Middeldorp Jan. 1990 19 p Sponsored in part by EEC
(CWI-CS-R9003; ETN-90-98096) Copyright Avail: NTIS HC/MF A03

A previous study showed that every term rewriting system with the unique normal form property can be conservatively extended to a confluent term rewriting system with the same set of normal forms. A simplified construction, which also yields a positive answer to a conjecture of the previous study stating that the normal form property is a modular property of left linear term rewriting systems, is given. The main result of the previous study, the modularity of unique normal forms, can be generalized to semi-equational term rewriting systems; however, for joint and normal conditional term rewriting systems the method fails. ESA

N91-12254# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
DISTRIBUTED TRANSITIVE CLOSURE COMPUTATIONS: THE DISCONNECTED SET APPROACH
Maurice A. W. Houtsma, Peter M. G. Apers, and Stefano Ceri (Modena Univ., Italy) Mar. 1990 41 p Sponsored in part by NFI and CNR
(Memo-INF-89-12; ISSN-0923-1714; ETN-90-98112) Copyright Avail: NTIS HC/MF A03

The recursion process of transitive closure is addressed. To gain speedup in processing for efficient computation, distributed (parallel) computation is considered. A disconnection set approach which fragments the data beforehand according to rules stemming from the application domain is introduced. It is applicable to several queries based on transitive closure such as connectivity, shortest path, and bill of materials. It can be generalized to work for other application domains. Example illustrations are given and the reformulation into independent subqueries is proved sound and complete. Relational algebra programs for actual computation are presented. Preliminary simulations which show that the approach leads to a speedup which is almost proportional to the number of processors without significant overhead are included. ESA

N91-12255# Universiteit Twente, Enschede (Netherlands). Information Systems Research Group.
KEY CONCEPTS AND THEIR INTERDEPENDENCIES IN THE MODELLING LANGUAGE OF MADIS
L. J. B. Essink Dec. 1989 65 p
(Memo-INF-89-72; ISSN-0923-1714; ETN-90-98114) Avail: NTIS HC/MF A04

The differences and commonalities of the Modelling Approach Designing Information Systems (MADIS) framework and a conceptual framework for understanding in information systems are discussed. A summary of the conceptual framework is given. A review report on a task group proposal for information systems methodologies, a framework for understanding, is given. The structure of the MADIS concepts are presented in a set of related semantic models. ESA

N91-12256# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
SPECIFICATION STYLES IN DISTRIBUTED SYSTEMS DESIGN AND VERIFICATION
C. A. Vissers, G. Scollo, M. vanSinderen, and E. Brinksma Feb. 1990 27 p Sponsored in part by EEC
(Memo-INF-90-06; ISSN-0923-1714; ETN-90-98115) Avail: NTIS HC/MF A03

Four specification styles which structure formal specifications in different ways, the monolithic, the constraint-oriented, the state oriented, and the source oriented style, are introduced. These styles were selected on the basis of their suitability to express design concerns by structuring specifications and their suitability to pursue qualitative design principles such as generality, orthogonality, and open endedness. By giving a running example, a query answer service, in the specification language LOTOS, these styles are discussed in detail. The support of verification and correctness preserving transformation by these styles is shown by verifying designs, expressed in different styles, with respect to each other. This verification is based on equational laws for (weak) bisimulation equivalence. ESA

N91-12257# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
COMPILER GENERATION BASED ON GRAMMAR INHERITANCE
Mehmet Askit, Rene Mostert, and Boudewijn Haverkort Feb. 1990 13 p
(Memo-INF-90-07; ISSN-0923-1714; ETN-90-98116) Avail: NTIS HC/MF A03

The concept of grammar inheritance is introduced. Grammar inheritance is a structural organization of grammar rules by which a grammar inherits rules from ancestor grammars or may have its own rules inherited by descendant grammars. Grammar inheritance supports reusability and extensibility of grammar rules. The concept of grammar inheritance is especially useful in combination with a compiler generator. A compiler generator tool for the SMALLTALK language which supports grammar inheritance is discussed. This tool was implemented on a Sun3 workstation and extensively tested. ESA

N91-12258# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
META-PARSING IN NEURAL NETWORKS
Anton Nijholt Feb. 1990 12 p Presented at 10th European Meeting on Cybernetics and Systems Research, Vienna, Austria, Apr. 1990 Revised
(Memo-INF-90-08-Rev; ISSN-0923-1714; ETN-90-98117) Avail: NTIS HC/MF A03

Constructing a connectionist network for context free language parsing can be compared with parsing sentences in such a way that the actual (pre)terminals or words become irrelevant. Only the structure of possible sentences is important. The notion of metaparsing is introduced to denote this way of constructing a network. The emphasis is on the building of the network rather than on the parsing. Properties such a network will have are discussed. The method is generalized to connectionist Earley parsing. In this case it is the construction of the network which gives rise to interesting observations about patterns of node configurations in the network. ESA

N91-12259# Universiteit Twente, Enschede (Netherlands). Knowledge-Based Systems Group.
CONVERSION OF RESOLUTION PROOFS INTO NATURAL DEDUCTION PROOFS M.S. Thesis
Hans Bosma Apr. 1990 105 p
(Memo-INF-90-11; UT-KBS-90-01; ISSN-0923-1714; ETN-90-98118) Avail: NTIS HC/MF A06

The presentation of automatically generated proofs in a format comprehensible for a user is studied. The conversion of resolution proofs into natural deduction proofs is considered worth investigating because of its natural and human oriented proof methods. The relationship between a system I used by Uiterwijk and Gentzen's original more extensive natural deduction system NK and LK is described. The conversion of I-profs into LK-proofs and NK-proofs is shown. As a result, the conversion of resolution proofs into comprehensible natural deduction proofs become feasible. A high level overview of a computer program that effectuates this conversion is given. Criteria for judging the comprehensibility of proofs are discussed. ESA

N91-12260# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
A FIRST ORDER LOGIC FOR PARTIAL FUNCTIONS BY MEANS OF NOTATIONAL CONVENTIONS
Jan Kuper 13 Mar. 1990 24 p
(Memo-INF-90-12; ISSN-0923-1714; ETN-90-98119) Avail: NTIS HC/MF A03

A problem in program logics is the possibility of non termination,

hence the logic must be suited to handle undefined terms. A solution based on ordinary first order predicate logic, and which proceeds by simple notational conventions, is presented. The approach is shown to be natural and flexible. For example, lambda abstraction may be introduced in this way. ESA

N91-12261# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
A CASE STUDY IN TRANSFORMATIONAL PROGRAMMING: THE DESIGN OF A RANK ORDER FILTER
Stef Joosten 6 Apr. 1990 18 p
(Memo-INF-90-18; ISSN-0923-1714; ETN-90-98120) Avail: NTIS HC/MF A03

Transformational programming is a technique in which computer programs are transformed into semantically equivalent programs by means of formal (algebraic) manipulation. A case study in which an implementation is formally derived from a formal specification is described. The validity of the technique of transformational programming by itself is not addressed nor its formal background. Case studies like this one are useful as a demonstration of the use of formal techniques in computing. A topic from hardware design, showing that this design activity is not necessarily restricted to computer programs is chosen. A popular digital filter, the rank order filter, is designed using concepts and notations from functional programming. ESA

N91-12262# Woods Hole Oceanographic Inst., MA.
VOICE: A SPECTROGRAM COMPUTER DISPLAY PACKAGE
Ann Martin, Josko A. Catipovic, Kurt Fristrup, and Peter L. Tyack Jun. 1990 100 p
(Contracts N00014-88-K-0273; N00014-87-K-0236)
(AD-A225214; WHOI-90-22) Avail: NTIS HC/MF A05 CSCL 09/2

A real-time spectrogram instrument has been developed to provide an inexpensive and field-portable instrument for the analysis of animal sounds. The instrument integrates a computer graphics display package with a PC-AT computer equipped with an A/D board and a digital signal processing board. It provides a real-time spectrogram display of frequencies up to 50kHz in a variety of modes: a running display, a signal halted on screen, successive expanded views of the signal. The signal amplitude may also be displayed. Portions of the scrolled data may be saved to disk file for future viewing, or as part of a database collection. The screen display may be manipulated to adapt to special needs. Program source listings are included in the text. GRA

N91-12263# Air Force Systems Command, Wright-Patterson AFB, OH.
PATTERN RECOGNITION METHOD
P. I. Potaturkin, P. Ye. Tverdokhleb, and Yu. V. Chuguy 5 Jun. 1990 7 p Transl. into ENGLISH of Russian Patent no. 456282, 21 Dec. 1972 p 1-2
(AD-A225263; FTD-ID(RS)R-0326-90) Avail: NTIS HC/MF A02 CSCL 17/5

This Russian patent claim is for a method of pattern recognition consisting in the modulation of a light flux with subsequent integration that is different because in order to increase the precision of recognition, the light flux is modulated according to the dispersion function on the X-axis, it is integrated on this same axis, and it is modulated according to the dispersion function on the Y-axis. GRA

N91-12264# Naval Postgraduate School, Monterey, CA.
COMPUTER GRAPHICS ADAPTATION OF SEVERAL AERODYNAMIC PREDICTION PROGRAMS M.S. Thesis
Craig M. MacAllister Dec. 1989 265 p
(AD-A225302) Avail: NTIS HC/MF A12 CSCL 20/4

The adaptation is described of six computer programs on the Micro VAX/2000/CAD/CAE workstation. Three of the programs, NEW DOUBLE, NEW PANEL, and NEW VOR, were originally transferred to the Aeronautical Engineering VAX System Server by LCDR John Campbell. Two of the programs (SUB and SUPER), both vortex lattice methods programs, were placed in the VAX system. The sixth program, a viscous interaction program was transferred/adapted to the VAX system. Extensive modifications were made to these programs to enhance their user interface. In addition, each program was adapted to provide interactive graphical/printed output. Furthermore, program NEW DOUBLE was modified to accept any arbitrary symmetrical shaped body. Lastly, NEW PANEL was altered to interface with the viscous interaction program in which boundary layer characteristics were determined. All user inputs in NEW DOUBLE, NEW PANEL and NEW VOR were also backed up with interactive checking routines. The programs were intended to be used by aeronautics/astronautics engineering students in basic and advanced courses in aerodynamics. GRA

N91-12265# Naval Postgraduate School, Monterey, CA. Dept. of Computer Science.
MULTIPROCESSOR SCHEDULING FOR HARD REAL-TIME SOFTWARE M.S. Thesis
Liangchuan Hsu Jun. 1990 112 p
(AD-A225332) Avail: NTIS HC/MF A06 CSCL 12/5

This thesis builds upon work previously done in the development of the Computer Aided Prototyping System (CAPS) and the Prototype System Description Language (PSDL) and presents a conceptual design for the pioneer prototype of the static scheduler for multiprocessors which are part of the CAPS execution support system. The design of hard real-time systems is gaining importance in the software engineering field as real-world processes are becoming automated. This increase in automation needs the advancement of software design technology to meet the design requirements for these hard real-time systems. The CAPS and PSDL are tools being developed to aid the software designer in the rapid prototyping of hard real-time systems. Scheduling PSDL operators in multiprocessor systems to meet the timing constraints is the main part of this thesis. Implementation of the conceptual design will be the basis for further work in this area. GRA

N91-12266# Naval Postgraduate School, Monterey, CA.
THE COMPUTER SIMULATION AND MODELING OF A FLEXIBLE MISSILE IN 2-D MOTION M.S. Thesis
Mehmet Aysel Dec. 1989 103 p
(AD-A225387) Avail: NTIS HC/MF A06 CSCL 16/2

The development and computer simulation of a bending flexible missile with a rigid-body controller system moving in a 2-D coordinate frame are discussed. In this thesis, the dynamic model was developed through the Equivalent Rigid Link System (ERLS) using Lagrangian dynamics to obtain a type of system equations of motion suited for the sequential integration method that integrates large motion explicitly and small motion implicitly. The spatial finite element discretization of missile structure and the application of truncated natural modal responses provide an approximate solution. The analysis and simulation were performed to understand the dynamic behavior of a flexible missile using a rigid-body controller. The payload will affect the natural frequency of the missile structure i.e., when the payload is increased, the system fundamental frequency will be decreased. The payload must then be limited to achieve high-speed response. In order to increase the payload and maintain high-speed control response, a flexible-body controller is needed. GRA

N91-12267# Naval Postgraduate School, Monterey, CA.
A MODEL FOR MERGING DIFFERENT VERSIONS OF A PSDL PROGRAM M.S. Thesis
David A. Dampier Jun. 1990 101 p
(AD-A225404) Avail: NTIS HC/MF A06 CSCL 12/5

As hardware complexity increases, software complexity increases, and software systems become less maintainable by manual methods. Automated software development methods, like Rapid Prototyping, have served to increase the maintainability of modern software systems, and increase customer participation in the requirements definition process. This makes software systems more maintainable and increases customer satisfaction with the first version of the system. Still, changes are inevitable. The part of the maintenance problem that automated tools currently do not

address, is the automatic propagation of changes through multiple versions of the same system. The Prototype System Description Language (PSDL) is a language used exclusively for designing and executing rapid prototypes. This thesis is directed at developing a model for automatically merging two different versions of a PSDL program, providing a method for propagating changes through multiple versions of that program. GRA

N91-12268# New York Univ., New York. Dept. of Computer Science.
RESEARCH IN NATURAL LANGUAGE PROCESSING Final Technical Report, 15 Jan. 1985 - 31 Mar. 1990
Ralph Grishman Jun. 1990 14 p
(Contract N00014-85-K-0163)
(AD-A225531; PROTEUS-M-35) Avail: NTIS HC/MF A03 CSCL 05/7

Primary interest is in the development of systems which can automatically process natural language text concerning limited domains. At the outset of our research, a number of research groups had created systems which could analyze some moderately complex tests. However, these systems were just demonstrations operating on small bodies of test, and were too fragile to become prototypes of operational systems (the few exceptions either operated on extremely simple test or extracted only a few predefined types of facts from a text). The central goal was to develop the techniques and tools which would allow us to create robust prototypes for operational systems. This central goal has led us to a wide variety of research in computational linguistics, from the development of parsers, grammars, and complete applications for text processing to basic research on issues of syntactic and semantic analysis. Summarized here are different research areas. Pointers to the memoranda, publications, and dissertations produced as part of this research are given. GRA

N91-12269# Texas Univ., Austin. Center for Cybernetic Studies.
SUGGESTED RESEARCH TOPICS IN SENSITIVITY AND STABILITY ANALYSIS FOR SEMI-INFINITE PROGRAMMING PROBLEMS
Anthony Fiacco and Yo Ishizuka (George Washington Univ., Washington, DC.) Apr. 1990 20 p
(Contract N00014-89-J-1537; NSF SES-87-22504; NSF ECS 86-19859)
(AD-A225540; CCS-RR-651) Avail: NTIS HC/MF A03 CSCL 12/4

We suggest several important research topics for semi-infinite programs whose problem functions and index sets contain parameters that are subject to perturbation. These include optimal value and optimal solution sensitivity and stability properties and penalty function approximation techniques. The approaches proposed are a natural carryover from parametric nonlinear programming, with emphasis on practical applicability and computability. GRA

N91-12270# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics.
EXECUTION AND EVALUATION OF COMPUTER ASSISTED EDUCATION IN THE FIELD OF GONIOMETRY [UITVOERING EN EVALUATIE VAN COO BIJ GONIOMETRIE]
H. J. Smid, J. Vastenhouw, and A. Verweij 1989 111 p In DUTCH
(Rept-89-79; ISSN-0922-5641; ETN-90-97694) Copyright Avail: NTIS HC/MF A06

The use and evaluation of courseware in teaching are studied. Courseware mainly means the developed software, but also the manual for the teachers and the information material for the students. The purpose and organization of the Computer Assisted Education (CAE) experiment are outlined. The opinions of students and teachers on the computer lessons are formulated. The teaching results are discussed. The benefits are mainly in the relations between students and teachers, and not so much in the cognitive field. The strongly directing character of the developed software is evaluated positively by the teachers. ESA

N91-12271# Technische Univ., Delft (Netherlands).
ITERATIVE METHODS IN IMAGE RECONSTRUCTION: THE RELATION BETWEEN ART, BLOCK-ART AND SIRT [ITERATIEVE METHODEN IN DE BEELDRECONSTRUCTIE: DE RELATIE TUSSEN ART, BLOCK-ART EN SIRT]
Marcel C. vanDijke, Henk A. vanderVorst, and Max A. Viergever (Utrecht State Univ., Netherlands) Nov. 1989 67 p In DUTCH Submitted for publication
(Rept-89-82; ISSN-0922-5641; ETN-90-97695) Copyright Avail: NTIS HC/MF A04

Iterative methods in image reconstruction, namely ART (Algebraic Reconstruction Technique) and the related methods block-ART and SIRT (Simultaneous Iterative Reconstruction Technique) are presented. The row-action method ART treats only one row of the systems matrix per iteration step. This is advantageous for problems with a large and sparse matrix. The method SIRT can be reduced to a special case of ART: ART with strong subrelaxation, but has the advantage of complete parallelization. It is shown that ART converges faster than block-ART and SIRT, if the ordering of the equations in ART is optimized. ESA

N91-12272# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
LOGIC PROGRAMS WITH NEGATION: CLASSES, MODELS, INTERPRETERS
Daniele Turi Oct. 1989 37 p
(CWI-CS-R8943; ETN-90-98076) Copyright Avail: NTIS HC/MF A03

A survey aimed at placing in a homogeneous framework disparate notions and results arising from the introduction of negation in logic programming is presented. The essence of the survey is described as follows. Positive logic programming is the combination of Horn clause logic with SLD-resolution. From the former it inherits a declarative semantics, from the latter a procedural one. The equivalence between these two semantics (completeness) is probably the most significant of (positive) logic programming. ESA

N91-12273# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
ADDITION CHAIN HEURISTICS
Jurjen N. E. Bos and Matthijs J. Coster Nov. 1989 12 p
(CWI-CS-R8945; ETN-90-98078) Copyright Avail: NTIS HC/MF A03

An algorithm based on heuristics for making an addition chain for a 512 bits number is explained. For fast computation, the precomputation method reduces the number of multiplications for the computation of a given power. Further work is suggested. ESA

N91-12274# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Iterative Systems.
AN APPROACH TO HIERARCHICAL INPUT DEVICES
D. A. Duce (Rutherford Appleton Lab., Chilton, England), R. vanLiere, and P. J. W. tenHagen Nov. 1989 19 p Submitted for publication
(CWI-CS-R8946; ETN-90-98079) Copyright Avail: NTIS HC/MF A03

The extension of a formal description of the Graphical Kernel System (GKS) input model to include hierarchically structured input devices is illustrated. It is shown how hierarchically structured input devices can be described as a composition of single level devices. The description follows the framework developed in the earlier format description. ESA

N91-12275# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Iterative Systems.
COMPONENTS, FRAMEWORKS AND GKS INPUT
D. A. Duce (Rutherford Appleton Lab., Chilton, England), R. vanLiere, and P. J. W. tenHagen Nov. 1989 19 p Submitted for publication

(CWI-CS-R8947; ETN-90-98080) Copyright Avail: NTIS HC/MF A03

The formal description of the Graphical Kernel System (GKS) input model given in Hoare's communicating sequential processes notation is illustrated and extensions in which some of the components in the GKS model are replaced by more interesting ones are explored. Some of the power and flexibility inherent in the component frameworks idea are thus demonstrated. The use of a formal notation led to a deepening of the authors' understanding of the input model and suggested some different ways of looking at the input model. ESA

N91-12276# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
EXTENDING S-INTERPRETATIONS TO LOGIC PROGRAMS WITH NEGATION
Daniele Turi Nov. 1989 17 p
(CWI-CS-R8948; ETN-90-98081) Copyright Avail: NTIS HC/MF A03

S-interpretations together with the notion of s-truth were previously used to define a least model semantics that resembles very much the least Herbrand model semantics and that provides a strongly complete declarative modeling for positive logic programming (i.e., Horn clause logic + SLD-resolution). Defining cs-interpretations as sets of constrained atoms, s-interpretations are extended to general programs (i.e., logic programs with negation). Chan's constructive negation inspired the definition and provides a procedural support for the declarative framework set up. In this, to define the notion of cs-truth, most general disunifiers between conjunctions of atoms and cs-interpretations are introduced. Stratified programs are general programs much related to positive ones. A fixpoint construction was previously introduced to produce a minimal Herbrand model which extends to stratified programs the least Herbrand model for positive programs, and an alternative characterization of such model was given (perfect Herbrand model). Applying these two constructs to cs-models, the unique perfect cs-model is obtained. A conjecture of a strong completeness for the cs-semantics wrt Przymusinski's interpreter for stratified programs and constructive negation (SLSC-resolution) is given. ESA

N91-12277# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
THE REFINEMENT THEOREM FOR ST-BISIMULATION SEMANTICS
R. J. vanGlabbeek Jan. 1990 25 p Submitted for publication
(CWI-CS-R9002; ETN-90-98095) Copyright Avail: NTIS HC/MF A03

ST-configurations to represent all the states of concurrent systems are introduced. ST-bisimulation equivalence is proved to be preserved under refinement of actions. This implies that it is possible to abstract from the causal structure of concurrent systems without assuming action atomicity. ESA

N91-12278# Technische Univ., Delft (Netherlands).
BOUNDS AND CONSTRUCTIONS FOR BINARY BLOCK CODES CORRECTING ASYMMETRIC OR UNIDIRECTIONAL ERRORS Ph.D. Thesis
Jacobus Hendricus Weber 1989 180 p
(ETN-90-98139) Avail: NTIS HC/MF A09

Error correcting block codes for reliable transmission or storage of data in a communication system using a binary channel are addressed. Symmetric, unidirectional and asymmetric error types are studied. Conditions for error detection and/or correction capabilities of block codes are derived. Upper bounds on the maximum cardinality of asymmetric or unidirectional error correcting codes are studied. Lower bounds, which can be obtained by constructing codes, are similarly studied. Bounds on the cardinality of codes that are linear are discussed. ESA

N91-11767# Royal Dutch Airlines, Amsterdam (Netherlands).
PARAMETER ESTIMATION FOR STOCHASTIC SYSTEMS
P. J. G. Loos *In* Tech. Univ. Delft, Essays on Stability and Control Oct. 1989 26 p (For primary document see N91-11759 03-09)
Avail: NTIS HC/MF A12

N91-11978*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.
LINEAR-PHASE APPROXIMATION IN THE TRIANGULAR FACET NEAR-FIELD PHYSICAL OPTICS COMPUTER PROGRAM
W. A. Imbriale and R. E. Hodges *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 47-56 (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N91-12279*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ANALOG-DIGITAL SIMULATION OF TRANSIENT-INDUCED LOGIC ERRORS AND UPSET SUSCEPTIBILITY OF AN ADVANCED CONTROL SYSTEM
Victor A. Carreno, G. Choi, and R. K. Iyer (Illinois Univ., Urbana.) Washington Nov. 1990 13 p
(NASA-TM-4241; L-16714; NAS 1.15:4241) Avail: NTIS HC/MF A03 CSCL 09B

A simulation study is described which predicts the susceptibility of an advanced control system to electrical transients resulting in logic errors, latched errors, error propagation, and digital upset. The system is based on a custom-designed microprocessor and it incorporates fault-tolerant techniques. The system under test and the method to perform the transient injection experiment are described. Results for 2100 transient injections are analyzed and classified according to charge level, type of error, and location of injection. Author

N91-12280# Wright Research Development Center, Wright-Patterson AFB, OH.
GRAPHICAL INFERENCE IN QUALITATIVE PROBABILISTIC NETWORKS Final Report, Mar. 1989 - Jun. 1990
Michael P. Wellman Jun. 1990 35 p
(AD-A225274; WRDC-TR-90-6002) Avail: NTIS HC/MF A03 CSCL 12/1

Qualitative probabilistic networks (QPNs) are abstractions of influence diagrams that encode constraints on the probabilistic relation among variables rather than precise numeric distributions. Qualitative relations express monotonicity constraints on direct probabilistic relations between variables, or on interactions among the direct relations. Like their numeric counterpart, QPNs facilitate graphical inference: methods for deriving qualitative relations of interest via graphical transformations of the network model. However, query processing in QPNs exhibits computational properties quite different from basic influence diagrams. In particular, the potential for information loss due to the incomplete specification of probabilities poses the new challenge of minimizing ambiguity. Analysis of the properties of QPN transformations reveals several characteristics of admissible graphical inference procedures. GRA

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N91-12281* Virginia Polytechnic Inst. and State Univ., Blacksburg.
SITUATIONALLY DRIVEN LOCAL NAVIGATION FOR MOBILE ROBOTS Ph.D. Thesis

Marc Glenn Slack 1990 202 p Sponsored in part by NASA, Washington and NSWC
Avail: Univ. Microfilms Order No. DA9028092 CSCL 09B

For mobile robots to autonomously accommodate dynamically changing navigation tasks in a goal-directed fashion, they must employ navigation plans. Any such plan must provide for the robot's immediate and continuous need for guidance while remaining highly flexible in order to avoid costly computation each time the robot's perception of the world changes. Due to the world's uncertainties, creation and maintenance of navigation plans cannot involve arbitrarily complex processes, as the robot's perception of the world will be in constant flux, requiring modifications to be made quickly if they are to be of any use. This work introduces navigation templates (NaT's) which are building blocks for the construction and maintenance of rough navigation plans which capture the relationship that objects in the world have to the current navigation task. By encoding only the critical relationship between the objects in the world and the navigation task, a NaT-based navigation plan is highly flexible; allowing new constraints to be quickly incorporated into the plan and existing constraints to be updated or deleted from the plan. To satisfy the robot's need for immediate local guidance, the NaT's forming the current navigation plan are passed to a transformation function. The transformation function analyzes the plan with respect to the robot's current location to quickly determine (a few times a second) the locally preferred direction of travel. This dissertation presents NaT's and the transformation function as well as the needed support systems to demonstrate the usefulness of the technique for controlling the actions of a mobile robot operating in an uncertain world. Dissert. Abstr.

N91-12282 Michigan State Univ., East Lansing.
OPTIMAL CONTROL IN CONSTRAINED MULTIBODY MECHANICAL SYSTEMS Ph.D. Thesis
MoonSuk Suh 1990 102 p
Avail: Univ. Microfilms Order No. DA9028685

Multi-body mechanical systems modeled in non-minimal coordinates have various advantages over systems in minimal sets of generalized coordinates. For example a system in non-minimal coordinates is simpler to model and important system measures (descriptor variables) are directly available. Unfortunately the many advantages of the non-minimal forms are nearly overcome by disadvantages due to the singularities of the system. Especially the standard forms of optimal control are not convenient for the systems represented in non-minimal coordinates (descriptor equations). The goal of this dissertation is to derive and test new and flexible forms of the necessary conditions of optimal control appropriate for multi-body systems in non-minimal coordinate sets. In order to derive the necessary conditions for optimal control, the problem is posed directly on an implicit system represented in non-minimal coordinates sets without reducing the second order form to the first order form. The approach follows the standard method of forming an augmented cost functional wherein the system is adjoined to a nonnegative by introducing adjoint variables. The second order implicit form necessary conditions for optimal control problems on multi-body mechanical systems models of non-minimal or descriptor form are presented. Dissert. Abstr.

N91-12283# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
ROBUST AND ADAPTIVE CONTROL Final Report, Jan. 1987 - Dec. 1989
Lena Valavani Apr. 1990 13 p
(Contract F08635-87-K-0031; AF Proj. 2304)
(AD-A224810; AFATL-TP-90-14) Avail: NTIS HC/MF A03 CSCL 12/2

This research deals with fundamental issues in robust and adaptive control, with emphasis on performance and stability robustness under parametric uncertainty and on the potential applications of such advanced control system design methods to the control of high performance vehicles such as the supermaneuverable aircraft and bank-to-turn missiles. GRA

N91-12284# Oregon Univ., Eugene. Dept. of Psychology.
EXPLORATIONS OF ANATOMY OF CONNECTIONIST MODELS FOR VISUAL LEXICAL ACCESS Final Report, 1 Nov. 1988 - 30 Apr. 1990
Michael I. Posner and Don M. Tucker 14 Jun. 1990 25 p
(Grant AF-AFOSR-0050-89; AF Proj. 2313)
(AD-A224845; AFOSR-90-0729TR) Avail: NTIS HC/MF A03 CSCL 05/2

A new state of the art Evoked Response Potential (ERP) laboratory was developed based on Macintosh computers and labview software that can record up to 64 channels of EEG input. This system is described along with its potential and a manual is included for its operation. In addition, two experiments were completed that show a distinction between words and consonant strings that is maximal for occipital lobe electrodes and that occurs within the first 250 millisec after input. In addition, words also differ from consonant strings in the lateral distribution of electrical activity over posterior temporal leads within the first 200 millisec following input. These two results conform to findings using PET suggesting an area sensitive to orthographic regularity in the left ventral occipital lobe (Snyder et al, 1989). GRA

N91-12285# Honeywell, Inc., Minneapolis, MN.
ADVANCED TOPICS IN ROBUST CONTROL. VOLUME 2: INVARIANTS AND STRUCTURED SINGULAR VALUES Final Technical Report, Apr. 1982 - Aug. 1990
Blaise Morton, John Doyle, Andrew Packard, and Allen Tannenbaum 1 Aug. 1990 40 p
(Contract N00014-82-C-0157)
(AD-A225219) Avail: NTIS HC/MF A03 CSCL 23/2

The topic is the theory of structured singular values in robust control analysis. Classical methods of invariant theory are applied to the problem of computing the structured singular value for the nonrepeated diagonal complex block structure. An algorithm for computing the structured singular value for the four-block problem is described. GRA

N91-12286# Michigan Univ., Ann Arbor.
ROBUSTNESS OF FEEDBACK SYSTEMS WITH SEVERAL MODELLING ERRORS Final Report, Mar. 1988 - Mar. 1990
James S. Freudenberg Jun. 1990 154 p
(Contract F33615-88-C-3601; AF Proj. 2304)
(AD-A225365; UM/EECS-025211-T-1; WRDC-TR-90-3018) Avail: NTIS HC/MF A08 CSCL 01/4

In this report we study robustness properties of linear multivariable feedback systems with several sources of modelling uncertainty. We assume that each source of uncertainty is modelled as a stable unstructured perturbation satisfying a frequency dependent norm bound. A stability margin for such an uncertainty description is furnished by the structured singular value. The structured singular value is obtained from a numerical optimization procedure. Consequently, it is difficult to obtain insight into the relation between its size and the plant, compensator, and design specifications upon which it depends. Our approach is to obtain such insight by deriving bounds and approximations to the structured singular value. The results we obtain are appealing in that they are both reasonably tight and in that they do provide the desired insight. We apply this insight first to understand the source of robustness difficulties associated with an ill-conditioned plant, and use the resulting information to develop a procedure for selecting weightings in Linear Quadratic Gaussian with Loop Transfer Recovery (LQG/LTR) and H-infinity synthesis problems so that the structured singular value is minimized. GRA

N91-12287# Royal Air Force Coll., Cranwell (England). Dept. of Electrical and Electronic Engineering.
SUPERVISORY CONTROL FOR ADAPTATIVE CONTROLLED PROCESSES M.S. Thesis
Alfred Carl Enman, Jr. 1989 113 p Prepared in cooperation with Loughborough Univ. of Technology, England
(ETN-90-98218) Copyright Avail: NTIS HC/MF A06

Aims are to examine the existing theory and practical applications of supervisory control, followed by the software design

of a supervisor for a nonlinear, adaptive controlled process. Ordinary negative feedback, adaptive and supervisory control systems are addressed. Stability monitoring in supervisors is reported. Software design specifications for a supervisor stability monitor/trend analyzer, the actual design in the form of Jackson diagrams, and a pseudo-code presentation are given. Significant conclusions are that the practical nature of the systems dictate the requirements for an expert system to determine what to do after the supervisor has detected a problem, and the supervisor/expert system combination shows potential for implementation with fast, real time, embedded systems plagued with limited computation time and storage space. ESA

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N91-12288 Stanford Univ., CA.
ROBUSTNESS OF LINEAR SYSTEMS TO PARAMETER VARIATIONS Ph.D. Thesis
Laurent Marc ElGhaoui 1990 211 p
Avail: Univ. Microfilms Order No. DA9024326

The dynamic behavior of many physical systems can be described by linear time-invariant (LTI) models. The stability robustness issue is addressed by defining a parameter margin for a plant with a given controller. It has the smallest l(sub q)-norm of real parameter deviations that produce instability. The l(sub 2) (Euclidian) norm corresponds to the largest stability hypersphere in parameter space. The l(sub infinity) norm corresponds to the largest stability box; it is equal to the inverse of the 'structured singular value with repeated real scalar blocks' found in mu analysis. The formulation is similar to mu analysis, with the new feature that all the input data are kept real. An efficient convex optimization algorithm is introduced to compute an accurate lower bound for the l(sub infinity) parameter margin. The two-parameter case is solved using a quadratically convergent algorithm, for both the l(sub 2) and l(sub infinity) norms; the special case when the parameters enter linearly in the closed-loop characteristic polynomial is solved exactly for all l(sub q)-norms, providing a generalization of the famous Kharitonov theorem. Several robustness analysis problems can be solved using this approach: discrete-time systems, relative stability, and aperiodicity. For robust control synthesis, it is assumed that the designer can select a finite number of 'most sensitive directions' in the parameter space. A heuristic procedure to select them is given. The robustness index J(sub R) is taken as the inverse of the smallest of the one-parameter margins along these directions. A trade off is made against a linear quadratic Gaussian finite-time performance index J(sub P) by minimizing, for a given trade-off weight of O less than or equal to rho and rho less than 1, the index J = (1-rho)J(sub P) + rho(J(sub R)), using the non-linear optimization routine NPSOL. Numerical synthesis examples illustrate the method.
Dissert. Abstr.

N91-12289# Instituto de Fisica Teorica, Sao Paulo (Brazil).
VARIATIONAL AND PERTURBATIVE SCHEMES FOR A SPIKED HARMONIC OSCILLATOR
V. C. Aguilera-Navarro, G. A. Estevez, and R. Guardiola (Granada Univ., Spain) 1989 24 p
(DE90-637409; IFT-P-10/89) Avail: NTIS (US Sales Only) HC/MF A03

A variational analysis of the spiked harmonic-oscillator Hamiltonian operator -d(exp 2)/dx(exp 2) + x(exp 2) + l(l+1)/x(exp 2) + lambda (absolute value of x)(exp -alpha), where alpha is a real positive parameter, is reported in this work. The formalism makes use of the functional space spanned by the solutions of the Schroedinger equation for the linear harmonic-oscillator Hamiltonian supplemented by a Dirichlet boundary condition, and a standard procedure for diagonalizing symmetric matrices. The eigenvalues obtained by increasing the dimension of the basis set provides accurate approximations for the ground-state energy of the model system, valid for positive and relatively large values of the coupling parameter lambda. Additionally, a large-coupling perturbative expansion is carried out and the contributions up to fourth order to the ground-state energy are explicitly evaluated. Numerical results are compared for the special case alphaequal 5/2. DOE

N91-12290# Illinois Univ., Urbana-Champaign. Dept. of Electrical Engineering.
RELIABLE CONTROL OF DECENTRALIZED SYSTEMS: AN ARE-BASED H-INFINITY APPROACH Ph.D. Thesis
Robert Joseph Veillette Jul. 1990 88 p
(Contracts N00014-90-J-1270; F33615-88-C-3604)
(AD-A224749; UILU-ENG-90-2225; DC-120) Avail: NTIS HC/MF A05 CSCL 12/1

A new method is presented of decentralized linear, time invariant control systems synthesis based on the algebraic Riccati equation (ARE). The basic decentralized design guarantees closed-loop stability and a predetermined level of worst case disturbance attenuation. Certain modifications of the basic design guarantee the stability and disturbance attenuation to be robust despite plant uncertainty or reliable despite control component outages. Other modifications guarantee that a subset of the controllers will be open-loop stable. The derived decentralized control law consists of a full order observer of the plant in each control channel. Each observer includes estimates of the controls generated by the other channels and of plant disturbance inputs, based on its own estimate of the state of the plant. All of the observer gains are computed from the solution of a single Riccati-like algebraic equation, while feedback gains are computed from a state feedback design ARE. The existence of appropriate solutions to the design equations is sufficient to guarantee the various properties of the closed-loop system. A convexity property of a certain matrix Riccati function allows parameterization of families of control laws with the same desired properties. Each value of the parameter results in controller of the same order as the plant. GRA

N91-12291# Naval Underwater Systems Center, New London, CT.
EVALUATION OF INTEGRALS AND SUMS INVOLVING (SIN(Mx)/SIN(x))(SUP n)
Albert H. Nuttall 18 May 1990 38 p Sponsored by Office of the Chief of Naval Research, Arlington, VA
(AD-A224906; NUSC-TR-8689) Avail: NTIS HC/MF A03 CSCL 12/1

The response of equispaced arrays, either linear, planar, or volumetric, to distributed spatial fields, typically encounters, integrals which involve the kernel sin(Mx)/sin(x) or its square. Since this kernel oscillates rather fast with x for large M and does not decay with x, numerical integration of such functions can be very time consuming. By resorting to Parseval's theorem, such integrals can be significantly simplified, requiring only the Fourier transform of the complementary part of the integrand. This procedure is investigated and applied to several typical examples; programs for the examples are also included. GRA

N91-12292# Johns Hopkins Univ., Baltimore, MD. Dept. of Electrical and Computer Engineering.
SMOOTHING FOR MULTIPOINT BOUNDARY VALUE MODELS
Howard L. Weinert 25 Jul. 1990 21 p
(Contract N00014-89-J-1642)
(AD-A224917; JHU/ECE-90-02) Avail: NTIS HC/MF A03 CSCL 12/2

Researchers show how to solve the linear least-squares smoothing problem for multipoint boundary value models. The complementary model is derived and is used to determine the Hamiltonian equations for the smoothed state estimate and its error covariance. Stable algorithms are obtained using an invariant imbedding/multiple shooting procedure. GRA

N91-12293# Rolls-Royce Ltd., Bristol (England).
DATA ANALYSIS

L. M. Jenkins Derby, England 6 Dec. 1989 38 p Presented at Institute of Metals Seminar on Characterization of High Temperature Materials. 5: Numerical Techniques, 6 Dec. 1989
(PNR-90749; ETN-90-97954) Copyright Avail: NTIS HC/MF A03

The integrity assessment of a component as a fundamental part of the design process is addressed. Materials data forms one of the major inputs into this assessment. The data includes physical and mechanical properties in addition to life estimation data. In most applications failures are at best inconvenient and usually the consequences are far worse. It is therefore necessary to design components to achieve a minimum life for a given level of risk. This requires the factoring of data from typical properties to minimum values associated with the risk level. ESA

N91-12294# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
ANALYSIS OF THE CONVERGENCE OF ITERATIVE IMPLICIT AND DEFECT-CORRECTION ALGORITHMS FOR HYPERBOLIC PROBLEMS
Jean-Antoine Desideri (Institut National de Recherche d'Informatique et d'Automatique, Valbonne, France) and Pieter W. Hemker Mar. 1990 88 p
(CWI-NM-R9004; ETN-90-98059) Copyright Avail: NTIS HC/MF A05

The convergence of unfactored implicit schemes for the solution of the steady discrete Euler equations is studied using first and second order accurate discretizations simultaneously. The close resemblance of these schemes with iterative defect correction is shown. Linear model problems are introduced for the one dimensional and the two dimensional cases. These model problems are analyzed in detail both by Fourier by matrix analyses. The convergence behavior appears to be strongly dependent on a parameter that determines the amount of upwinding in the discretization of the second order scheme. The linear convection problem in one and two dimensions is studied in detail. Differences between the various cases are signaled. Experiments for the Euler equations are shown, including comments on how the theory is well or partially verified depending on the problem. ESA

N91-12295# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
AN EVALUATION ON THE GRADIENT-WEIGHTED MOVING-FINITE ELEMENT METHOD IN ONE SPACE DIMENSION
P. A. Zegeling and J. G. Blom Mar. 1990 30 p Submitted for publication
(Contract CWI-59-0922)
(CWI-NM-R9006; ETN-90-98061) Copyright Avail: NTIS HC/MF A03

The Moving Finite Element (MFE) method for solving parabolic and hyperbolic Partial Differential Equations (PDEs) is studied. To investigate to what extent gradient weighted MFE can be called robust, reliable and effective for the automatic solution of time dependent PDEs in one space dimension, the method is tested extensively on a set of five relevant example problems with a different solution behavior. All tests were carried out using the Backward Differentiation Formula (BDF) time integrator SPGEAR of the existing method-of-lines software package SPRINT. ESA

N91-12296# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Analysis, Algebra and Geometry.
FINITE-DIMENSIONAL SOLITON SYSTEMS
S. N. M. Ruijsenaars Feb. 1990 45 p Submitted for publication Sponsored by Netherlands Organization for the Advancement of Research
(CWI-AM-R9005; ETN-90-98062) Copyright Avail: NTIS HC/MF A03

Results concerning Calogero-Moser and Toda systems and integrable generalizations thereof are surveyed. Relations to infinite dimensional integrable systems are discussed. The study is limited to the physically most relevent case of relation invariant interactions. The classical and quantum versions of the integrable systems are addressed. Results on explicit action-angle transformation which lead particularly to duality relations are given. The quantum translations of duality relations are explained in connection with a description of explicit knowledge concerning the action-angle and joint eigenfunction transform. Explicit knowledge concerning the action-angle and joint eigenfunction transforms is emphasized. Connections which have emerged so far are outlined. ESA

N91-12297# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Analysis, Algebra and Geometry.
THE CENTER MANIFOLD FOR DELAY EQUATIONS IN THE LIGHT OF SUNS AND STARS
Odo Diekmann and Stephan A. vanGils (Universiteit Twente, Enschede, Netherlands) Mar. 1990 23 p
(CWI-AM-R9007; ETN-90-98063) Copyright Avail: NTIS HC/MF A03

The center manifold theorem for retarded functional differential equations is stated and proved. The method of proof is based on the variation of constants formula in the framework of dual semigroups. As an application, Hopf bifurcation is addressed. ESA

N91-12298# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Analysis, Algebra and Geometry.
FROM BINARY TO GREY-LEVEL MORPHOLOGY
H. J. A. M. Heijmans May 1990 37 p
(CWI-AM-R9009; ETN-90-98065) Copyright Avail: NTIS HC/MF A03

The construction of morphological operators on spaces of grey level functions is studied. The approach adopted is to represent a function by a sequence of threshold sets and to transform this sequence into another one. This can be done by applying the same set operator at any level: the resulting operator is called a flat operator. A different set operator could be applied at each level. Or alternatively, the threshold sets can be transformed recursively, using the outcome at a certain grey level for the computation at the next level. ESA

N91-12299# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
ON CUTTING PLANES AND MATRICES
A. M. H. Gerards Nov. 1989 8 p
(CWI-BS-R8930; ETN-90-98067) Copyright Avail: NTIS HC/MF A02

Continuing the work of Chvatal and Gomory, Schrijver proved that any rational polyhedron has finite Chvatal rank. This was extended by Cook, Gerards, Schrijver and Tardos, who proved that this Chvatal rank can be bounded from above by a number only depending on A, so independent of b. A study which aims to show that the latter result can be proved quite easily from the result of Chvatal and Schrijver is presented. ESA

N91-12300# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
ENUMERATION AND VISIBILITY PROBLEMS IN INTEGER LATTICES
Evangelos Kranakis and Michel Pocchiola (Centre National de la Recherche Scientifique, Paris, France) Dec. 1989 17 p
(CWI-CS-R8949; ETN-90-98082) Copyright Avail: NTIS HC/MF A03

Enumeration and visibility problems of the d-dimensional integer lattice L (limits d and n) of d-tuples of integers less than or equal to n are studied. Several useful enumeration principles are given and used to study the asymptotic behavior of the number of straight lines traversing a certain fixed number of lattice vertices of L (limits d and n), the line incidence problem and the edge visiblity region. An art gallery problem for point obstacle is studied. More specifically, the camera placement problem for the infinite lattice

L (upper limit d) is studied. A lattice point is visible from a camera C (positioned at a vertex of L (upper limit d)) if the line segment joining A and C crosses no other lattice vertex. For any given number s less than or equal to 3 (upper limit d) of cameras, the position they must occupy in the lattice L (upper limit d) in order to maximize their visibility is determined. ESA

N91-12301# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
DERIVING DENOTATIONAL MODELS FOR BISIMULATION FROM STRUCTURED OPERATIONAL SEMANTICS
J. J. M. M. Rutten Dec. 1989 20 p
(CWI-CS-R8955; ETN-90-98088) Copyright Avail: NTIS HC/MF A03

As a starting point, the notion of Labelled Transition System (LTS) in the style of the structured operational semantics of Plotkin is taken. Every LTS gives rise to a model that maps the states of the LTS (usually terms over some signature) to a representation of their bisimulation equivalence class, namely a so-called process. (Such a model is often called operational). These processes are elements of a metric domain which was first introduced by De Bakker and Zucker. It is shown how the transition system specification (a set of rules for deriving transitions) by which the LTS is defined, induces a denotational model, given that it satisfies certain syntactic restrictions. Both models are proved equal by showing that they are fixed points of the same contraction, which has a unique fixed point by Banach's theorem. ESA

N91-12302# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
AN EFFICIENT ALGORITHM FOR BRANCHING BISIMULATION AND STUTTERING EQUIVALENCE
Jan Friso Groote and Frits Vaandrager Jan. 1990 16 p Submitted for publication Sponsored in part by EEC
(CWI-CS-R9001; ETN-90-98094) Copyright Avail: NTIS HC/MF A03

An efficient algorithm for the Relational Coarsest Partition with Stuttering problem (RCPS) is presented. The RCPS problem is closely related to the problem of deciding stuttering equivalence on finite state Kripke structures, and to the problem of deciding branching bisimulation equivalence on finite state labelled transition systems. If n is the number of states and m the number of transitions, then the algorithm has time complexity and stuttering equivalence which have the same complexity O(n(n + m)) and space complexity 0(n + m). The algorithm induces algorithms for branching bisimulation and stuttering equivalence which have the same complexity. Since for Kripke structures (m is less than or equal to n squared), this confirms a conjecture of Browne, Clarke and Grumberg, that their O(n to the 5th power) time algorithm for stuttering equivalence is not optimal. ESA

N91-12303# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
ELEMENTARY STRUCTURES OF NON-ATOMIC EVENTS
Arend Rensink Mar. 1990 26 p Sponsored by EEC
(Memo-INF-89-65; ISSN-0923-1714; ETN-90-98113) Avail: NTIS HC/MF A03

Event structures based on nonatomic events are discussed. Such structures called here organic event structures, possess not one but two ordering relations, representing precedence and influence. Given a hierarchy of events, organic events structures capture precisely the relation over arbitrary sets of events if the hierarchical structure is forgotten. Elementary (atomic) event structures are not powerful enough for this purpose. Some organic event structures can be interpreted by sets of time intervals. Necessary and sufficient conditions for the existence of interpretations in preordered, partially ordered and totally ordered time, are given. The subclass of organic event structures that can be interpreted by non-overlapping intervals is almost, but not quite, equivalent to the class of atomic event structures. ESA

N91-12304# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
AN EXPONENTIAL FITTING METHOD IN TWO DIMENSIONS
R. R. P. vanNooyen Feb. 1990 22 p Submitted for publication
(CWI-NM-R9005; ETN-90-98060) Copyright Avail: NTIS HC/MF A03

A Petrov-Galerkin form of exponential fitting for a mixed finite element formulation of the semiconductor continuity equations on a rectangular domain is discussed. Conditions, that ensure theta (h) bounds for the L squared (omega) norm of the error are given. The constants in the error bound do not contain exponentials of the electrical potential. ESA

N91-12305# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Analysis, Algebra and Geometry.
ON THE TOPOLOGY INDUCED BY THE ADJOINT OF A SEMIGROUP OF OPERATORS
J. M. A. M. vanNeerven May 1990 17 p
(CWI-AM-R9010; ETN-90-98066) Copyright Avail: NTIS HC/MF A03

The adjoint of C sub 0-semigroup on a Banach space X induces a locally convex sigma(X,X dot circled)-topology in X, which is weaker than the weak topology of X. The relation between these two topologies is studied. Among other things a class of subsets of X is given on which they coincide, an Eberlein-Shmulyan type theorem is proved for the sigma(X,X dot circled)-topology and some applications are given. ESA

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N91-12306# Ballistic Research Labs., Aberdeen Proving Ground, MD.
POLYNOMIAL DEFINITION OF DISCRETE FIELD POINTS OF MAP OF DIFFUSION EQUATION, PART 2 Memorandum Report, Jan. - Dec. 1989
William F. Donovan Jul. 1990 24 p
(DA Proj. 1L1-62618-AH-80)
(AD-A224595; BRL-MR-3836-Pt-2) Avail: NTIS HC/MF A03 CSCL 12/1

A solution is indicated for the basic diffusion equation of physics where the field boundary extends from zero to positive infinity. The nodal points of the field net are identified as terminating polynomials with the numerators of the coefficients found first by deduction--for the lower orders--and then by extrapolation. It will consider the numerical analysis employed to complete the entire set of tables. GRA

N91-12307# Tennessee Univ., Knoxville. Dept. of Psychology.
DIFFERENTIAL WEIGHT PROCEDURE OF THE CONDITIONAL P.D.F. APPROACH FOR ESTIMATING THE OPERATING CHARACTERISTICS OF DISCRETE ITEM RESPONSES Technical Report, 1987 - 1990
Fumiko Samejima 25 Jun. 1990 35 p
(Contract N00014-87-K-0320; NR Proj. RR0-4204)
(AD-A224697; ONR-RR-90-4) Avail: NTIS HC/MF A03 CSCL 12/3

A new procedure of nonparametric estimation of the operating characteristics of discrete item responses is proposed, and it is called differential weight Procedure of the Conditional Probability Distribution Function (PDF) Approach. Some examples are given, and sensitivities of the resulting estimated operating characteristics to irregularities of the differential weight functions are observed and discussed. Usefulnesses of the method is also discussed. These outcomes suggest the importance of further investigation of the weight function in the future. GRA

N91-12308# Tennessee Univ., Knoxville. Dept. of Psychology.
MODIFICATIONS OF THE TEST INFORMATION FUNCTION
Technical Report, 1987 - 1990
Fumiko Samejima 30 Jun. 1990 39 p
(Contract N00014-87-K-0320; NR Proj. RR0-4204)
(AD-A224698; ONR-RR-90-1) Avail: NTIS HC/MF A03 CSCL 12/3

A minimum bound of any estimator, biased or unbiased, is considered, and, based on that, Modification Formula No. 1 is proposed for the maximum likelihood estimator, in place of the test information function. A minimum bound of the mean squared error is considered, and, based on that, Modification Formula No. 2 in the same context is proposed. Examples are given, and the usefulnesses of these modified test information functions in computerized adaptive testing are discussed. These topics are also discussed and observed for the monotonically transformed latent variable. GRA

N91-12309# Army Armament Munitions and Chemical Command, Rock Island, IL. Systems Analysis Office.
STATISTICAL DECISIONS UTILIZING NEURAL NETS
Memorandum Report, Jan. - Mar. 1990
Jack Manata and George Schlenker 30 May 1990 48 p
(AD-A224752; AMSMC/SA-MR-9004) Avail: NTIS HC/MF A03 CSCL 12/3

Neural networks were developed that accurately determine the statistical characteristics: modality and number of stochastic components of underlying probability distribution(s) for sample data. Sample data examples, used to teach the neural nets were generated utilizing either a single beta distribution or a mixture of beta distributions. Once the neural net learned to distinguish between unimodal and multimodal examples and also between unimodal and mixture densities, they were challenged with unknown test cases. The test cases were also generated from either a single beta distribution or a mixture of beta distributions. Therefore the initial test results apply to a restricted class of distributions having bounded domains. The initial testing of the neural networks consisted of 40 unknown sample data examples generated utilizing beta distributions. The results of these tests are: (1) correctly identified 39 out of the 40 as being either unimodal or multimodal, an accuracy of 97.5 percent. This exceeds the accuracy of currently available statistical methods; (2) correctly identified 36 out of 40 as having either one component or more than one component, an accuracy of 90 percent. GRA

N91-12310# Texas A&M Univ., College Station. Dept. of Statistics.
GOODNESS OF FIT TESTS AND ENTROPY
Emanuel Parzen May 1990 13 p
(Contract DAAL03-90-G-0069)
(AD-A224860; TR-103; ARO-27574.2-MA) Avail: NTIS HC/MF A03 CSCL 12/3

The unifying role of entropy statistics and concepts is discussed in developing goodness of fit tests for a parametric model F(x;Theta) for a continuous distribution function F(x), given a random sample from the distribution F. Statistics discussed are those by Moran (extended by Cheng and Stephens), Vasicek and Dudewicz and van der Meulen (based on gap estimators of quantile density function), Parzen (autoregressive estimators of quantile density functions), and shapiro and Wilk. They are given unified formulations as entropy difference statistics. Their 95 percent significance levels for sample sizes 20 and 50 are compared and shown to increase as amount of smoothing decreases. GRA

N91-12311# European Space Agency, Paris (France).
AN APPLICATION OF TESTS OF SIGNIFICANCE TO POINT AND CONFIDENCE ESTIMATION AND TO TEST MODEL VERIFICATION FOR PARAMETER IDENTIFICATION
Fro Hammelrath (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) Aug. 1990 28 p Transl. into ENGLISH of Anwendung von Signifikanztests fuer Punkt- und Bereichsschaetzungen und fuer die Ueberpruefung der Zugrunde Gelegten Modelle bei der Parameteridentifizierung (Brunswick, Fed. Republic of Germany, DFVLR), Dec. 1988 31 p Original language document was announced as N89-26666
(ESA-TT-1152; DFVLR-Mitt-88-34; ETN-90-98006) Avail: NTIS HC/MF A03

A Monte Carlo formula is propsed for statistical cases with unknown test distribution. The hypothetical model is used to simulate a certain number of measurement series for which there applies the hypothesis which must accordingly be tested, calculating the corresponding simulated test variable values of actual observations. A substitute hypothesis is examined. The formal facilities for application of significance tests in systems identification are set. ESA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N91-12312# Strategic Defense Initiative Organization, Washington, DC.
REPORT TO THE CONGRESS ON THE STRATEGIC DEFENSE INITIATIVE, 1990
May 1990 177 p
(AD-A224950) Avail: NTIS HC/MF A09 CSCL 15/3

This report recounts the progress the SDI program has made over the last several years and describes our plans for the future. One of the biggest breakthroughs occurred recently: the introduction of the Brilliant Pebbles concept into the space-based portion of the defense architecture. Preliminary cost estimates and effectiveness analyses indicate that deployment of Brilliant Pebbles as the space-based layer of a Phase One Strategic Defense System could allow savings of $14 billion from previous estimates, reducing the cost of an initial system from $69 billion to approximately $55 billion. In 1989, we launched the Beam Experiment Aboard a Rocket (BEAR), which demonstrated propagation of a particle beam in space. Also in 1989, we witnessed the first firing of the Alpha chemical laser. In 1990, we plan to achieve even more significant testing milestones. In January, we launched the first High Endo-Atmospheric Defense Interceptor (HEDI) test and demonstrated the ability to cool the interceptor's forebody and sensor window. We are demonstrating defensive technologies that we believe offer the potential for moving toward a more stable relationship with the Soviet Union while reducing offensive forces. In sum, our efforts to demonstrate defensive technologies, to modernize our offensive forces and to work toward beneficial arms control agreements are fully integrated and mutually reinforcing. GRA

N91-12313# Pittsburgh Univ., PA. Learning Research and Development Center.
ADAPTIVE SEARCH THROUGH CONSTRAINT VIOLATIONS
Stellan Ohlsson and Ernest Rees Jan. 1990 25 p Sponsored in part by Xerox Corp.
(Contract N00014-89-J-1681; NR Proj. RR0-4206)
(AD-A225553; UPITT/LRDC/ONR/KUL-90-01) Avail: NTIS HC/MF A03 CSCL 12/4

Restructuring consists of a change in the representation of the current search state, a process which breaks an impasse during problem solving by opening up new search paths. A corpus of 52 think-aloud protocols from the domain of geometry was scanned for evidence of restructuring. This data suggest that restructuring is accomplished by re-parsing the geometric diagram. GRA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

No abstracts in this category.

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N91-12314# State Univ. of New York, Buffalo. Dept. of Chemistry.
SPECIFIC HEAT OF ANISOTROPIC SUPERCONDUCTORS
Devaraj Sahu, Andreas Langner (Rochester Inst. of Tech., NY.), and Thomas F. George Jul. 1990 8 p Submitted for publication
(Contract N00014-90-J-1193)
(AD-A225031; UBUFFALO/DC/90/TR-18) Avail: NTIS HC/MF A02 CSCL 20/3

A theoretical approach for obtaining a Ginzburg-Landau free-energy expansion for a class of even-parity superconducting states that enables the calculation of thermodynamic quantities for heavy-fermion and other conventional superconductors is discussed. Anisotropic superconducting states that enables the calculation of thermodynamic quantities for heavy-fermion and other conventional superconductors is discussed. GRA

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N91-12315*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
WAKE GEOMETRY EFFECTS ON ROTOR BLADE-VORTEX INTERACTION NOISE DIRECTIVITY
R. M. Martin, Michael A. Marcolini, W. R. Splettstoesser, and K.-J. Schultz (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) Nov. 1990 23 p Original contains color illustrations
(NASA-TP-3015; L-16723; NAS 1.60:3015) Avail: NTIS HC/MF A03; 6 functional color pages CSCL 20A

Acoustic measurements from a model rotor wind tunnel test are presented which show that the directionality of rotor blade vortex interaction (BVI) noise is strongly dependent on the rotor advance ratio and disk attitude. A rotor free wake analysis is used to show that the general locus of interactions on the rotor disk is also strongly dependent on advance ratio and disk attitude. A comparison of the changing directionality of the BVI noise with changes in the interaction locations shows that the strongest noise radiation occurs in the direction of motion normal to the blade span at the time of interaction, for both advancing and retreating side BVI. For advancing side interactions, the BVI radiation angle down from the tip-path plane appears relatively insensitive to rotor operating condition and is typically between 40 and 55 deg below the disk. However, the azimuthal radiation direction shows a clear trend with descent speed, moving towards the right of the flight path with increasing descent speed. The movement of the strongest radiation direction is attributed to the movement of the interaction locations on the rotor disk with increasing descent speed.
Author

N91-12316*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NEAR-FIELD NOISE OF A SINGLE-ROTATION PROPFAN AT AN ANGLE OF ATTACK
M. Nallasamy, E. Envia (Sverdrup Technology, Inc., Brook Park, OH.), B. J. Clark, and J. F. Groeneweg Oct. 1990 20 p Presented at the 13th Aeroacoustics Conference, Tallahassee, FL, 22-24 Oct. 1990; sponsored in part by AIAA
(NASA-TM-103645; E-5805; NAS 1.15:103645; AIAA-90-3953) Avail: NTIS HC/MF A03 CSCL 20A

The near field noise characteristics of a propfan operating at an angle of attack are examined utilizing the unsteady pressure field obtained from a 3-D Euler simulation of the propfan flowfield. The near field noise is calculated employing three different procedures: a direct computation method in which the noise field is extracted directly from the Euler solution, and two acoustic-analogy-based frequency domain methods which utilize the computed unsteady pressure distribution on the propfan blades as the source term. The inflow angles considered are -0.4, 1.6, and 4.6 degrees. The results of the direct computation method and one of the frequency domain methods show qualitative agreement with measurements. They show that an increase in the inflow angle is accompanied by an increase in the sound pressure level at the outboard wing boom locations and a decrease in the sound pressure level at the (inboard) fuselage locations. The trends in the computed azimuthal directivities of the noise field also conform to the measured and expected results. Author

N91-12317*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EMERGING APPLICATIONS OF HIGH TEMPERATURE SUPERCONDUCTORS FOR SPACE COMMUNICATIONS
Vernon O. Heinen, Kul B. Bhasin, and Kenwyn J. Long Sep. 1990 12 p Presented at the World Congress on Superconductivity, Houston, TX, 10-13 Sep. 1990
(NASA-TM-103629; E-5797; NAS 1.15:103629) Avail: NTIS HC/MF A03 CSCL 20A

Proposed space missions require longevity of communications system components, high input power levels, and high speed digital logic devices. The complexity of these missions calls for a high data bandwidth capacity. Incorporation of high temperature superconducting (HTS) thin films into some of these communications system components may provide a means of meeting these requirements. Space applications of superconducting technology has previously been limited by the requirement of cooling to near liquid helium temperatures. Development of HTS materials with transition temperatures above 77 K along with the natural cooling ability of space suggest that space applications may lead the way in the applications of high temperature superconductivity. In order for HTS materials to be incorporated into microwave and millimeter wave devices, the material properties such as electrical conductivity, current density, surface resistivity and others as a function of temperature and frequency must be well characterized and understood. The millimeter wave conductivity and surface resistivity were well characterized, and at 77 K are better than copper. Basic microwave circuits such as ring resonators were used to determine transmission line losses. Higher Q values than those of gold resonator circuits were observed below the transition temperature. Several key HTS circuits including filters, oscillators, phase shifters and phased array antenna feeds are feasible in the near future. For technology to improve further, good quality, large area films must be reproducibly grown on low dielectric constant, low loss microwave substrates. Author

N91-12318# Texas Univ., Austin. Applied Research Lab.
NONLINEAR ACOUSTICS: PROPAGATION IN A PERIODIC WAVEGUIDE AND SCATTERING OF SOUND BY SOUND
Annual Summary Report No. 2, 1 Oct. 1989 - 30 Sep. 1990
David T. Blackstock 17 Jul. 1990 27 p
(Contract N00014-89-J-1109)
(AD-A224738; ARL-TR-90-21) Avail: NTIS HC/MF A03 CSCL 20/1

Propagation in a periodic waveguide is a combined theoretical and experimental study of acoustic Bloch waves in a rectangular, air filled waveguide that is periodically loaded with reactive branch elements. Second harmonic distortion was investigated. A quasilinear solution of the generalized Westervelt equation, with

certain terms neglected, showed that although the fundamental Bloch wave is progressive, the second harmonic Bloch wave has both forward traveling and backward traveling components. Experimental measurements generally confirmed the theoretical predictions. Scattering of sound by sound was studied by analysis of the effect of various source boundary conditions on the scattered field. The project is mainly experimental, however. The tank facility where the experiments on scattering will be carried out, was completed. A series of three different experiments is planned. Some work was also done on an upgrade of the Nonlinear Acoustics Lab and measurements of ellipsoidal focusing of spark produced N waves. GRA

N91-12319# David Taylor Research Center, Bethesda, MD. Dept. of Propulsion and Auxiliary Systems.
USE OF RADIATION EFFICIENCY IN NOISE CONTROL ENGINEERING Research and Development Report
J. Dickey, G. Maidanik, and J. Ertel (Naval Academy, Annapolis, MD.) Jun. 1990 25 p
(AD-A225054; DTRC-90/019) Avail: NTIS HC/MF A03 CSCL 20/1

The radiation efficiency is defined in terms of the power that is radiated by a structure, the absolute square of the normal velocity on the surface integrated over that surface, and the characteristic impedance of the fluid facing the surface. The utilization of the radiation efficiency as a useful engineering quantity for describing the radiation from panel-like structures and for the estimation of the effectiveness of measures that may be used to control the radiated power from such structures is questioned. Caution needs to be exercised in the use of the radiation efficiency for these purposes. GRA

N91-12320# Pennsylvania State Univ., University Park. Dept. of Physics.
ACOUSTIC STUDIES OF NEW MATERIALS: QUASICRYSTALS, LOW-LOSS GLASSES, AND HIGH Tc SUPERCONDUCTORS Annual Summary Report, 1 Oct. 1989 - 30 Sep. 1990
Julian D. Maynard 1 Aug. 1990 29 p
(Contract N00014-85-K-0701)
(AD-A225190) Avail: NTIS HC/MF A03 CSCL 09/1

The goals of this project involve the development and application of new techniques in acoustics. The goals are: (1) to study the properties of single crystal high temperature superconductor oxide materials with ultrasonic measurements; (2) to study the properties of quasicrystals using ultrasound and acoustic analog systems; and (3) to develop and apply a new resonant photo-acoustic technique to measure optical absorption in very low-loss glasses and crystals. Major accomplishments include the development of a new method of ultrasound elastic constants of very small samples (a few hundred microns in size), and the development and test of a new technique for measuring optical absorption with more than an order of magnitude improvement in sensitivity over existing methods. GRA

N91-12321# European Space Agency, Paris (France).
BULK ACOUSTIC WAVE RESONATORS MADE OF AMORPHOUS MATERIALS
Michel Breuzet (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) Aug. 1990 202 p Transl. into ENGLISH of Resonateurs a Ondes Elastiques de Volume en Materiaux Amorphes (Paris, France, ONERA), 1989 165 p Original language document was announced as N90-17416
(ESA-TT-1201; ONERA-NT-1989-1; ETN-90-98012) Avail: NTIS HC/MF A10

The investigation of plates vibrating at radio frequency and made of amorphous conductive or insulating materials is carried out. Capacitive excitation was employed for this type of resonator made of non piezoelectric material. The advantage of using contour vibration modes is demonstrated, with particular reference to the Lame mode. The optimization of mountings designed to minimize resonator/mounting coupling is investigated. The finite element computing method was applied. The results obtained on resonators made of AU4G and vitreous silica (SiO2) are discussed. ESA

N91-12322# Institut Franco-Allemand de Recherches, Saint-Louis (France).
NOISE PREDICTION FOR A THREE-DIMENSIONAL BLADE/LINE VORTEX INTERACTION
M. Schaffar, J. Haertig, and P. Gnemmi 19 Jul. 1990 15 p Presented at Euromech Colloquium 247, Goettingen, Fed. Republic of Germany, 28 Jun. - 1 Jul. 1989
(ISL-CO-226/89; ETN-90-98035) Avail: NTIS HC/MF A03

The vortex lattice method is described and applied in order to predict the aerodynamic loads on a thin one-bladed rotor. A local conformal mapping for each position in span is used to transform the thin blade into a thick one. The pressure coefficients obtained for the thick blade are fed into an acoustic code which is based on Ffowcs-Williams-Hawkings equation. For a first calculation, the blade vortex interaction is simplified: the wake shedded by the previous blades is contracted into a vortex line and the interaction occurs near an azimuth angle of 40 degrees (advancing blade). The calculated noise shows that the horizontal directively has a maximum in the forward direction and the computed pressure signatures are very similar to the measured signatures found in the literature. ESA

N91-12323# Technical Research Centre of Finland, Espoo. Lab. of Heating and Ventilation.
ANALYSIS METHODS FOR ACOUSTICAL SYSTEMS BASED ON THE FFT AND INTENSITY TECHNIQUES Ph.D. Thesis
Tapio Lahti Aug. 1990 293 p Sponsored by Finnish Foundation of Technology
(VTT-67; ISBN-951-38-3760-2; ISSN-0358-5069; ETN-90-98233)
Copyright Avail: NTIS HC/MF A13; Governement Printing Center, P.O. Box 516, SF-00101 Helsinki, Finland, HC 170 Finnish marks

A two part study on the measurement and analysis of acoustical systems is presented, consisting of the development of various methods based on the Fast Fourier Transform (FFT) and intensity, and a collection of experiments for testing their applicability. The measurements were made with a dual channel FFT analyzer, and the 2-D space-wavenumber FFT is used in some subsequent analyses. Most of the methods and experiments are related to the two transducer sound intensity techniques. The presented methods extend possibilities available for investigating more complicated acoustical systems such as the window. ESA

N91-11717# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
INTERIOR NOISE CONTROL PROGRAM FOR THE ADVANCED COMMUTER AIRCRAFT DORNIER 328 AND FIRST RESULTS
I. U. Borchers, H. J. Hackstein, M. Gruenewald, and C. Weigwieser *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 73-83 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

N91-11718# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Technical Acoustics Div.
DLR AIRCRAFT NOISE RESEARCH AND TESTING TECHNIQUES RELATED TO PROPELLER DRIVEN AEROPLANE NOISE CERTIFICATION
Hanno Heller and Werner Dobrzynski *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 85-96 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

N91-11719# Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany, F.R.).
AIRCRAFT ENGINE NOISE
F. Kennepohl *In* DGLR, European Forum: The Evolution of Regional Aircraft Technologies and Certification 1989 p 97-104 (For primary document see N91-11707 03-03)
Avail: NTIS HC/MF A10

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N91-12324# California Univ., Santa Barbara. Dept. of Physics.
QUANTUM COHERENCE OF A NARROW BAND INTERACTING WITH PHONONS AND STATIC DISORDER Technical Report, 1 Jan. - 31 Dec. 1990
Qian Niu Aug. 1990 59 p Submitted for publication
(Contract N00014-89-J-1530)
(AD-A224658; TR-31) Avail: NTIS HC/MF A04 CSCL 20/12

This work deals with the quantum dynamics of a narrow band particle interacting with phonons and static disorder. The present theory is exact in the limit of small band width compared with the Debye energy, and covers various regimes in the parameter space of temperature and disorder strength. Therefore, the theory provides a unified framework for studying when and how the particle motion changes from coherent band like behavior to incoherent hopping, as the temperature and/or disorder strength are increased. The theory also includes the double well problem as a special case, where rather complete description of the particle motion is obtained. GRA

N91-12325# Harry Diamond Labs., Adelphi, MD.
MOBILITY OF NONEQUILIBRIUM CONDUCTION ELECTRONS IN AIR Final Report, Oct. 1988 - Sep. 1989
William T. Wyatt, Jr. and Christopher S. Kenyon Jun. 1990 51 p Sponsored by Army Lab. Command, Adelphi, MD
(AD-A224909; HDL-TR-2184) Avail: NTIS HC/MF A04 CSCL 20/9

An integro-differential equation is derived describing the time evolution of the electron energy distribution function in a gas in a transient electric field. A finite difference approximation and a time stepping algorithm using matrix-vector techniques are devised to solve the integro-differential equation. An extensive published cross section set is added to the time stepping algorithm, enabling one to calculate realistic energy distribution functions in air. Also described is a projection method that allows computation of electron swarm properties such as collision volume (inversely related to mobility) using measured data for equilibrium distributions. This projection method is shown to have desirable variational properties in calculating the swarm properties. Compare orthogonal and nonnegative projection methods with conventional techniques for their ability to reduce error in estimates of collision volume arising from cross section induced error in the energy distribution function. A single-vector projection with cleanup of approximation error performs best, leading to significant reduction of collision volume error when the distribution function maximum occurs at not more than about 0.1 eV. Other projections perform poorly compared to conventional methods of calculating swarm collision volume, because of inherent dependence of the projection basis of equilibrium distributions and resulting ill-conditioning of the projection matrix. GRA

N91-12326# Maryland Univ., College Park. Dept. of Electrical Engineering.
INVESTIGATION OF THE PROPAGATION OF INTENSE CHARGED PARTICLE BEAMS INTO VACUUM Final Technical Report, 1 May 1987 - 30 Apr. 1990
William W. Destler Jul. 1990 128 p
(Grant AF-AFOSR-0091-84; AF Proj. 2301)
(AD-A225098; AFOSR-90-0840TR) Avail: NTIS HC/MF A07 CSCL 20/7

Laser-controlled beamfront accelerator experiments achieved gradients of up to 40 MV/m and proton acceleration to 18 MeV over 40 cm with a beam energy of 900 keV. Beamfront electric field degradation requirements beam energy to be increased as the gradient is increased. An experiment with a beam energy of 1.5 MeV achieved a 60 MV/m gradient in a 100 cm distance, matching theoretical models. Experiments with pseudospark discharges achieved electron beams of 25 kV, 1000 A/sq cm, 10 ns with 10(11) A/sq(m-rad) brightness. Theory indicates densities greater than 10(3) A/sq cm and brightness greater than 10(11) A/sq(m-rad) are achievable. GRA

N91-12327# Los Alamos National Lab., NM. Neutron Scattering Center.
THE EFFECT OF SURFACE ROUGHNESS ON THE PHASE OF NEUTRONS SPECULARLY REFLECTED AT GRAZING INCIDENCE
W. A. Hamilton and R. Pynn 1990 6 p Presented at the Workshop on Methods of Analysis and Interpretation of Neutron Reflectivity Data, Argonne, NM, 23-25 Aug. 1990 Submitted for publication
(Contract W-7405-eng-36)
(DE91-000238; LA-UR-90-3127; CONF-9008161-1) Avail: NTIS HC/MF A02

The effect of surface roughness on the specular intensity of a reflected neutron beam can be calculated using the distorted wave Born approximation. For Gaussian roughness the result obtained is the familiar expression of Nevot and Croce. When the distribution of surface heights, z, is proportional to cosh/2(z/2d), the calculated reflectance is sinh(pi d k sub 0 -k sub 1)/ sinh(pi d k sub 0 +k sub 1). Here k sub 0 and k sub 1 are the components of neutron wavevectors perpendicular to the interface, evaluated outside and inside the reflecting medium, and d is a measure of the amplitude of the roughness. This result for the reflectance differs by a phase factor from that obtained in an exact calculation for an interface with the corresponding graded refractive index. The phase difference between the two expressions is small, scaling as approx. d sup 3, and usually has little effect on measured reflectivities of multilayered structures. Ways in which the phase could be determined are discussed. DOE

N91-12328# New Mexico State Univ., Las Cruces.
EXPERIMENTAL STUDIES OF NUCLEON-NUCLEON AND PION-NUCLEUS INTERACTIONS AT INTERMEDIATE ENERGIES Progress Report, 1 Apr. 1988 - 31 Mar. 1991
1 Oct. 1990 54 p
(Contract DE-FG04-88ER-40403)
(DE91-000605; DOE/ER-40403/T2) Avail: NTIS HC/MF A04

This report summarizes the work on experimental research in intermediate energy nuclear and particle physics carried out by New Mexico State University in 1988 to 1991. Most of these studies have involved investigations of neutron-proton and pion-nucleus interactions. The neutron-proton research is part of a program of studies of interactions between polarized nucleons which has continued for more than ten years. Its purpose was to help complete the determination of the full set of ten complex nucleon-nucleon amplitudes at energies up to 800 MeV, as well as to continue investigating the possibility of the existence of dibaryon resonances. The given complex isospin-one amplitudes were fairly well determined, partly as a result of this work. The work in this period has involved measurements and analysis of data on elastic scattering and total cross sections for polarized neutrons on polarized protons. The pion-nucleus research continues the studies of this interaction in regions where it was not well explored. One set of experiments includes studies of pion elastic and double-charge-exchange scattering at energies between 300 and 550 MeV, where the data is unique. Another involves elastic and single-charge-exchange scattering of pions from polarized nuclear targets, a new field of research which will give the first extensive set of information on spin-dependent pion-nucleus amplitudes. Still another involves the first set of detailed studies of the kinematic correlations among particles emitted following pion absorption in nuclei. DOE

N91-12329# Amsterdam Univ. (Netherlands).
THEORETICAL CALCULATIONS FOR ELECTRON PROTON SCATTERING Ph.D. Thesis
Melis vanderHorst, Jr. 1990 109 p Submitted for publication
(ETN-90-97748) Avail: NTIS HC/MF A06

As an extension of a discussion of the production of standard model Higgs bosons at the HERA collider and the possibilities of producing charged Higgs bosons at HERA are discussed. Both

the elastic and inelastic processes, electron/proton reaction e-H+H-p , and electron/proton reaction e-H+H-X, are considered. The e-p reaction gamma e-p as a fast luminosity monitor for the HERA collider is discussed. Quantum electrodynamic radiative corrections to the process e-p reaction gamma e-p are addressed. Concise expressions for traces of gamma matrices in four dimensions are given. ESA

N91-12330# Amsterdam Univ. (Netherlands).
OFF-SHELL EFFECTS IN ELECTROMAGNETIC REACTIONS Ph.D. Thesis
Henricus Wilhelmus L Naus 1990 147 p Submitted for publication Sponsored by Stichting voor Fundamenteel Onderzoek der Materie, and Netherlands Organization for the Advancement of Pure Research
(ETN-90-97749) Avail: NTIS HC/MF A07

The electromagnetic properties of off-shell nucleons are studied. Gauge invariance provides an important constraint. The electromagnetic interaction of a many body system is described, a Lagrangian formulation is used to illustrate the connections with analagous problems discussed, and the nonrelativistic Ward-Takahashi identities are derived. The general formalism of the off-shell electromagnetic vertex of a Dirac particle is presented. Off-shell effects in electron-nucleus scattering is addressed. The description of electromagnetic two step reactions involving hadrons when the internal structure of the hadrons is taken into account is discussed. General vertex operators are used, only constrained by Lorentz and gauge invariance. The electromagnetic production of pions on a nucleon is discussed as an example. ESA

N91-12331# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Physics.
INTERACTION OF THE POSITRON AND THE POSITRONIUM ATOM WITH INSULATING FLUIDS AND SOLIDS Ph.D. Thesis
Maarit Tuomisaari Finnish Academy of Technology 1990 36 p
(Ph-165; ISBN-951-666-300-1; ISSN-0355-2721; ETN-90-97975) Avail: NTIS HC/MF A03

Experimental positron lifetime results in argon and xenon indicate, and theoretical calculations confirm, the clustering of atoms around the positron and the bubble formation around the positronium atom in a certain temperature and density range. The results may be generalized to practically all gases at temperatures not too far from the critical temperature. Positronium time of flight measurement on solid rare gases and several alkali halides indicate that energetically narrow positronium distributions are formed in the interior of wind band gap insulators. The energy distributions are well described by the Ore formation model. The energetic positronium formed at the positron implant depth diffuses to the surface, losing energy in the process. An analysis of the data using hot-carrier diffusion model simulations yields an estimate of the strength of the positronium-phonon coupling. The coupling is found to be energy dependent. ESA

N91-12332# Alabama Univ., University. Dept. of Physics and Astronomy.
CALCULATION OF SPECTROSCOPIC PARAMETERS FOR DIATOMIC MOLECULES OF ATMOSPHERIC INTEREST Final Report, 2 Sep. 1987 - 31 Mar. 1990
R. H. Tipping Mar. 1990 19 p
(Contract F19628-87-K-0055)
(AD-A225251; GL-TR-90-0127) Avail: NTIS HC/MF A03
CSCL 20/8

A complete recalculation of fundamental spectroscopic parameters, in particular transitional frequency and line intensity, was accomplished for the diatomic molecules carbon monoxide (CO), and the hydrogen halides (HF, HCl, HBr, and HI). The results were cast into the form of the 1986 edition of the HITRAN molecular database. A primary goal of this effort was to produce parameters sufficient for the high temperature database, HITEMP, so that additional isotopic variants and additional hot and overtone bands for these species are included, also extending the bands to higher rotational levels than previously available. The spectral coverage is from the submillimeter region (pure rotational lines) through the visible (higher overtones). GRA

N91-12333# Technische Univ., Delft (Netherlands).
EXCHANGE CURRENTS IN THE RADIATIVE CAPTURE OF THERMAL NEUTRONS BY PROTONS AND DEUTERONS Ph.D. Thesis
Mark Willem Konijnenberg 1990 106 p Sponsored by Netherlands Energy Research Foundation
(ETN-90-98138) Avail: NTIS HC/MF A06

Measurements on the ratio between the contributions to the radiative neutron capture process by deuterons from states with total spin J = 1/2 and J = 3/2 are presented. It is shown that the outcome of these experiments can only be understood from the electromagnetic interactions with nucleons, mesons and nucleon resonances involving meson exchange. These mesons are the logical consequence of the fact that the strong nucleon-nucleon interaction potential is mediated by these particles. ESA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N91-12334# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
THERMOIONIC CONVERTER FOR SPACE REACTOR
Shengquan Cao and Jicai Yang 4 May 1990 14 p Transl. into ENGLISH from He Ke Xue Yu Gong Cheng (Peoples Republic of China), v. 4, no. 3, Sep. 1984 p 227-232
(AD-A225299; FTD-ID(RS)T-0385-90) Avail: NTIS HC/MF A03
CSCL 10/2

Thermionic converters offer many advantages for use as space reactors. Over the last several years, six experiments were performed, of which four were in-pile experiments and two out-pile experiments. Of the four in-pile experiments, three involved the use of three converters linked in series. The use of nuclear reactors as the power source for an electrical system in space is one of the important developmental projects under consideration today. For a time extending relatively long into the future, according to most opinions on potential power requirements, the choice of a thermionic converter to implement thermoelectric conversion has many advantages. GRA

74 OPTICS

Includes light phenomena; and optical devices.

For lasers see *36 Lasers and Masers.*

N91-12335*# Arizona Univ., Tucson. Optical Sciences Center.
[SCALING LAWS FOR LIGHT WEIGHT OPTICS, STUDIES OF LIGHT WEIGHT MIRRORS MOUNTING AND DYNAMIC MIRROR STRESS, AND LIGHT WEIGHT MIRROR AND MOUNT DESIGNS] Final Report, 1 Apr. 1989 - 30 Apr. 1990
Daniel Vukobratovich, Ralph M. Richard, Tina M. Valente, and Myung K. Cho Apr. 1990 129 p
(Contract NCC2-426)
(NASA-CR-187368; NAS 1.26:187368) Avail: NTIS HC/MF A07
CSCL 20F

Scaling laws for light-weight optical systems are examined. A cubic relationship between mirror diameter and weight has been suggested and used by many designers of optical systems as the best description for all light-weight mirrors. A survey of existing light-weight systems in the open literature was made to clarify this issue. Fifty existing optical systems were surveyed with all varieties of light-weight mirrors including glass and beryllium structured mirrors, contoured mirrors, and very thin solid mirrors.

These mirrors were then categorized and weight to diameter ratio was plotted to find a best curve for each case. A best fitting curve program tests nineteen different equations and ranks a goodness-to-fit for each of these equations. The resulting relationship found for each light-weight mirror category helps to quantify light-weight optical systems and methods of fabrication and provides comparisons between mirror types. Author

N91-12336*# Stanford Univ., CA. Dept. of Electrical Engineering.
DESIGN AND IMPLEMENTATION OF INTERFACE UNITS FOR HIGH SPEED FIBER OPTICS LOCAL AREA NETWORKS AND BROADBAND INTEGRATED SERVICES DIGITAL NETWORKS
Fouad A. Tobagi, Ismail Dalgic, and Joseph Pang 31 Oct. 1990 38 p
(Contract NCC10-001)
(NASA-CR-187384; NAS 1.26:187384) Avail: NTIS HC/MF A03 CSCL 20F

The design and implementation of interface units for high speed Fiber Optic Local Area Networks and Broadband Integrated Services Digital Networks are discussed. During the last years, a number of network adapters that are designed to support high speed communications have emerged. This approach to the design of a high speed network interface unit was to implement package processing functions in hardware, using VLSI technology. The VLSI hardware implementation of a buffer management unit, which is required in such architectures, is described. Author

N91-12337# Virginia Polytechnic Inst. and State Univ., Blacksburg. Fiber and Electro-Optics Research Center.
ULTRA-LOW LOSS OPTICAL FIBER CHARACTERIZATION SYSTEM DEVELOPMENT Final Report
R. G. May, K. D. Bennett, and R. O. Claus 1 Jun. 1990 116 p
(Contract N00014-88-K-2013)
(AD-A224843) Avail: NTIS HC/MF A06 CSCL 17/5

The IR System 1 is an automated optical bench designed for the measurement of spectral attenuation differential model attenuation, and numerical aperture of zirconium fluoride infrared optical fiber. It is a specially adapted version of a commercially available FOA-2000, a silica fiber characterization system. The system measures spectral attenuation over the range from 600 nm to 4 microns. Launch conditions are overfilled for multimode fibers with core diameters up to 150 microns and with numerical apertures up to 0.24. The fiber vacuum chucks can accept fibers with outside diameters up to 200 microns. The attenuation is derived by performing a cut-back test. GRA

N91-12338# Army Natick Labs., MA.
OPTICAL TRANSMISSION PROPERTIES OF SELECTED SHELTER MATERIALS Final Report, 1 Jun. - 1 Sep. 1988
Richard G. Quynn and Louis J. Dittami Aug. 1990 21 p
(AD-A225072; NATICK/TR-90/043) Avail: NTIS HC/MF A03 CSCL 11/5

Eight candidate tentage fabrics were evaluated for blackout (opacity to light transmission at night) in the laboratory and in the field with both incandescent and fluorescent lighting. A good correlation was obtained. Of the candidates examined, only the Hypalon-coated fabrics showed satisfactory blackout properties for visible and nonvisible wavelengths. The standard cotton duck (MIL-C-43627) was satisfactory only for visible radiation. GRA

N91-12339# Connecticut Univ., Storrs. Dept. of Electrical Engineering.
NONLINEAR JOINT TRANSFORM PROCESSOR Final Technical Report, Sep. 1988 - Aug. 1989
Bahram Javidi Jun. 1990 37 p
(Contract F30602-88-D-0025)
(AD-A225091; RADC-TR-90-105) Avail: NTIS HC/MF A03 CSCL 12/7

A nonlinear joint transform image correlator is investigated. The Fourier transform interference intensity is threshold to provide higher correlation peak intensity and better defined correlation spot. Analytical expressions for the threshold joint power spectrum is provided. The effects of the nonlinearity at the Fourier plane on the correlation signals at the output plane is investigated. The correlation signals are determined in terms of the nonlinear characteristics of the spatial light modulator (SLM) at the Fourier plane. It is shown that thresholding the interference intensity results in a sum of infinite harmonic terms. Each harmonic term is envelope modulated due to the nonlinear characteristics of the device, and phase modulated by m times the phase modulation of the nonthresholded joint power spectrum. The correct phase information about the correlation signal is recovered for the first order harmonic of the threshold interference intensity. GRA

N91-12340# Universiteit Twente, Enschede (Netherlands).
SIGNAL DETECTION AND INTERPRETATION IN SCANNING OPTICAL MICROSCOPY Ph.D. Thesis
Jozet Petrus Henricu Benschop 1989 174 p Prepared in cooperation with Philips International B.V., Eindhoven, Netherlands
(ISBN-90-9002791-2; UDC-681.723(043.3); ETN-90-97774)
Copyright Avail: NTIS HC/MF A08

Theoretical models used to calculate the response of two types of Scanning Optical Microscopes (SOMs), one using pupil detection and the other confocal detection, are investigated. The response due to objects having lateral dimensions and heights which are comparable to the wavelength of the light was focused on. Three theoretical models are presented and the signals predicted by them are compared with experimental results. The use of SOMs in the inspection of integrated circuits is addressed. A scalar model which calculates the response of a SOM using transfer functions and object spectra and a vectorial model are presented. The reflection coefficient's dependence on the angle of incidence is taken into account. The experimental setup is described. ESA

N91-12341# Sira Inst. Ltd., Chislehurst (England).
FIBRE OPTIC ANEMOMETRY USING AN OPTICAL DELAY CAVITY TECHNIQUE
B. T. Meggit (Kings Coll., London, England), W. J. O. Boyle, K. T. V. Grattan, and A. W. Palmer 1990 9 p Presented at Sira/SPIE Conference on Fiber Optics Sensors 90, London, England, 23-26 Apr. 1990 Sponsored by United Kingdom Science and Engineering Research Council Prepared in cooperation with City Univ., London, England
(ETN-90-97966) Avail: NTIS HC/MF A02

Limitations on the performance and capabilities of conventional fiber optic Doppler anemometers are highlighted in the context of fluid flow measurement. In order to overcome these difficulties, a novel optical fiber signal processing scheme is outlined, based on a low coherence interferometric approach using an optical delay cavity matched for the position of the required measurement volume. Both a homodyne and a heterodyne system are discussed and experimental results are presented to verify the feasibility of the proposed method. ESA

N91-12342# Naval Postgraduate School, Monterey, CA.
AUTOMATED FIBER OPTIC MEASUREMENTS M.S. Thesis
Francisco C. Pantoja Dec. 1989 103 p
(AD-A225328) Avail: NTIS HC/MF A06 CSCL 20/6

The objective was to implement an automated optical measurement system for use with fiber optic systems. This system controls data acquisition, processes the acquired data and optimally displays results of optical experiments. The primary constituents of the experimental design were: a Hewlett-Packard HP-87 used as the computer controller, the Tektronix OF235 Reflectometer, the Photodyne 22XLA Fiber Optic Multimeter and the 2275XQ Test Set. These devices were integrated through the General Purpose Interface Bus (GPIB) and software was developed to control the operation of the system. The system is capable of measuring many fiber parameters such as attenuation, index of refraction, loss characteristics as well as detecting and locating faults and breaks in single-mode fibers. In addition, the system possesses peripheral devices to store the data and to produce permanent records of the results. GRA

N91-12343# Syracuse Univ., NY.
MICROFABRICATION TECHNOLOGY FOR PHOTONICS Final Report, Jun. 1988 - Jun. 1989
David W. Woodard Jun. 1990 51 p Prepared in cooperation with Cornell Univ., Ithaca, NY
(Contract F30602-88-D-0027)
(AD-A225428; RADC-TR-90-111) Avail: NTIS HC/MF A04 CSCL 09/5

This study identifies key research in the area of photonics microfabrication technology. Discussions are presented on optical non-linearity, bistability, fundamental problems in digital optical processing, generic micro-structures needed for integrated photonics and the fabrication technology used in their realization, equipment needed for such technology with quoted price ranges where available, major equipment for optional or future consideration and laboratory space and special service requirements. GRA

N91-11818# Aerospatiale Aquitaine, Saint-Medard en Jalles (France). Strategic and Space Div.
STRUCTURAL MATERIALS FOR SPACE MIRRORS
C. Capitanio *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 39-43 (For primary document see N91-11812 03-24)
Copyright Avail: NTIS HC/MF A19

N91-11819# Contraves Corp., Zurich (Switzerland). Space Div.
OPTICAL INTERFEROMETER SYSTEMS IN SPACE: CONFIGURATION AND STRUCTURE CONCEPTS USING SPACE RIGIDIZED ELEMENTS
M. C. Bernasconi, S. Koese, and W. J. Rits (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Space Applications of Advanced Structural Materials Jun. 1990 p 47-56 Previously announced in IAA as A90-13554 (For primary document see N91-11812 03-24)
(Contract ESA-6975/86/NL/PH)
Copyright Avail: NTIS HC/MF A19

N91-11976*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
DESIGN OF A FIBER-OPTIC TRANSMITTER FOR MICROWAVE ANALOG TRANSMISSION WITH HIGH PHASE STABILITY
R. T. Logan, Jr., G. F. Lutes, L. E. Primas, and L. Maleki *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 27-33 Sponsored in part by RADC (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 20F

N91-12405*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ACCELERATION EFFECTS OBSERVED IN OPTICAL DATA TAKEN IN SPACELAB 3 FES
James Trolinger, Ravindra Lal (Alabama A & M Univ., Huntsville.), and Rudy Ruff *In its* Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 25 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 20F

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N91-12344*# California Univ., Los Angeles. Dept. of Physics.
CURRENTS BETWEEN TETHERED ELECTRODES IN A MAGNETIZED LABORATORY PLASMA
R. L. Stenzel and J. M. Urrutia [1989] 70 p
(Grant NAGw-1570)
(NASA-CR-186128; NAS 1.26:186128) Avail: NTIS HC/MF A04 CSCL 20I

Laboratory experiments on important plasma physics issues of electrodynamic tethers were performed. These included current propagation, formation of wave wings, limits of current collection, nonlinear effects and instabilities, charging phenomena, and characteristics of transmission lines in plasmas. The experiments were conducted in a large afterglow plasma. The current system was established with a small electron-emitting hot cathode tethered to an electron-collecting anode, both movable across the magnetic field and energized by potential difference up to V approx.=100 T(sub e). The total current density in space and time was obtained from complete measurements of the perturbed magnetic field. The fast spacecraft motion was reproduced in the laboratory by moving the tethered electrodes in small increments, applying delayed current pulses, and reconstructing the net field by a linear superposition of locally emitted wavelets. With this technique, the small-amplitude dc current pattern is shown to form whistler wings at each electrode instead of the generally accepted Alfven wings. For the beam electrode, the whistler wing separates from the field-aligned beam which carries no net current. Large amplitude return currents to a stationary anode generate current-driven microinstabilities, parallel electric fields, ion depletions, current disruptions and time-varying electrode charging. At appropriately high potentials and neutral densities, excess neutrals are ionized near the anode. The anode sheath emits high-frequency electron transit-time oscillations at the sheath-plasma resonance. The beam generates Langmuir turbulence, ion sound turbulence, electron heating, space charge fields, and Hall currents. An insulated, perfectly conducting transmission line embedded in the plasma becomes lossy due to excitation of whistler waves and magnetic field diffusion effects. The implications of the laboratory observations on electrodynamic tethers in space are discussed. Author

N91-12345# International Atomic Energy Agency, Vienna (Austria).
PASSIVE CONTROL OF VERTICAL INSTABILITIES IN ITER
M. Yamane, E. Coccorese, and M. Sugihara (Japan Atomic Energy Research Inst., Ibaraki.) Sep. 1989 23 p
(DE90-706120; INIS-mf-12629) Avail: NTIS (US Sales Only) HC/MF A03

The paper presents the results of the scoping studies carried out for ITER during the spring/summer 1988 in the field of the vertical stabilization of plasma. After a brief introduction, the calculational results based on two different models are presented and commented; then, the conclusions drawn are presented to show how the vertical stabilization problem may impose limitations and/or requirements both on physical parameters (primarily the plasma elongation) and on technological solutions for the first wall/blanket (primarily the number of torus sectors) of ITER. Main results and conclusions of this scoping study have been summarized and included in the respective chapters of the ITER Concept Definition Report. DOE

N91-12346# Ceskoslovenska Akademie Ved, Prague. Inst. of Plasma Physics.
ON OPTIMIZATION OF THE LARGE LAUNCHING STRUCTURES FOR THE LOWER HYBRID CURRENT DRIVE
O. Hurtak Sep. 1989 27 p
(IPPCZ-296) Avail: NTIS HC/MF A03

The origin of secondary peaks in the power spectrum of a launching structure consisting of multijunction sections is analyzed generally by means of an approximate formula for the power spectrum. Results of numerical optimization of a concrete structure with three-waveguide multijunction sections are given. It is shown that the basic electrical length of the multijunction section cannot be chosen in such a way that both a sufficient reduction of the peaks and a favorable power distribution among waveguides be achieved simultaneously. The difficulties are eliminated by the use of aperiodically excited multijunction sections resulting in equalization of phases of incident waves in waveguides. Author

N91-12347# Ceskoslovenska Akademie Ved, Prague. Inst. of Plasma Physics.
AN OHMIC HEATING CIRCUIT FOR THE CASTOR TOKAMAK
M. Valovic Jul. 1989 15 p
(IPPCZ-295) Avail: NTIS HC/MF A03

The simple ohmic heating circuit which prolongs the stationary phase on the CASTOR tokamak is described. It is a low-cost system which allows to prolong the CASTOR discharges to a limit given by the toroidal magnetic field pulse. Higher plasma currents can be attained by a reduction of the circuit resistance and by a pre-magnetization of the iron core transformer. It will, however, imply the different scheme for the bias vertical magnetic field. A test 19 kA discharge with duration of 40 ms is presented.
Author

N91-12348# Naval Research Lab., Washington, DC. Radiation Hydrodynamics Branch.
NON-MAXWELLIAN ELECTRON DISTRIBUTION FUNCTIONS IN z-PINCH PLASMAS Interim Report
P. E. Pulsifer and K. G. Whitney 27 Jul. 1990 58 p Sponsored by DNA, Washington, DC
(AD-A224702; NRL-MR-6662) Avail: NTIS HC/MF A04 CSCL 20/9

The heating and cooling a a z-pinch electron distribution is studied using the Fokker Planck equation. Included in the analysis are the usual Fokker Planck term for distant small angle electron-electron collisions, a semi-empirical term representing inelastic charge conserving collisions, ohmic heating by the electric field acting on the current, and compressional heating or cooling. Ions are represented as heavy, highly charged Maxwellian particles, and electron-ion collisions are given in terms of a Coulomb collision frequency. In deriving the Fokker Planck equation, a first order Cartesian tensor expansion is performed in a local coordinate system which is spatially uniform and moving with the fluid. The first order (vector) term in the expansion is assumed to equilibrate much faster than the zero order (scalar) term. Under some conditions, the electron distribution function has an analytic self-similar solution. A numerical time dependent solution is also obtained, through an implicit finite differencing scheme. Advantages of a time dependent model are noted. The behavior of the electron distribution function and conductivity are demonstrated for different parameters. Production of runaway electrons with perpendicular electric and magnetic fields is discussed. GRA

N91-12349# Rice Univ., Houston, TX. Dept. of Electrical and Computer Engineering.
COLLISIONALLY EXCITED XUV AND VUV COHERENT SOURCES Final Report, 1 Jun. 1987 - 31 May 1990
P. Jeffrey Wisoff 31 May 1990 46 p
(Grant AF-AFOSR-0247-87; AF Proj. 2301)
(AD-A224728; AFOSR-90-0809TR) Avail: NTIS HC/MF A03 CSCL 20/6

Three types of excitation have been explored including soft x ray pumping from laser-produced plasmas, electron beam pumping, and pulsed jet discharge pumping. Using the laser produced plasmas, new quasimetastable states of barium which radiate in the x ray ultraviolet (XUV) have been explored and new vacuum ultraviolet (VUV) radiating molecules have been produced. Electron beam pumping has also resulted in the formation of ionic excimer molecules which radiate in the VUV, and considerable kinetic studies were performed to examine the feasibility of producing a VUV laser by this technique. This included the development of the necessary technology to allow electron beam pumping of reactive vapors at approximately 700 C and still maintaining compatibility with VUV detection equipment. Using the third excitation technique, pulsed jet discharge pumping, the formation of highly excited ions from the sputtering of low vapor pressure materials used in the pulsed jet nozzle were studied. GRA

N91-12350*# Naval Research Lab., Washington, DC. Lab. for Computational Physics and Fluid Dynamics.
NUMERICAL SIMULATION OF THE COMPRESSIBLE ORSZAG-TANG VORTEX 2. SUPERSONIC FLOW Interim Report
J. M. Picone and Russell B. Dahlburg 5 Aug. 1990 45 p Sponsored by NASA, Washington and ONR, Arlington, VA
(NASA-CR-185877; NAS 1.26:185877; AD-A224913; NRL-MR-6690) Avail: NTIS HC/MF A03 CSCL 20/9

The numerical investigation of the Orszag-Tang vortex system in compressible magnetofluids will consider initial conditions with embedded supersonic regions. The simulations have initial average Mach numbers 1.0 and 1.5 and beta 10/3 with Lundquist numbers 50, 100, or 200. The behavior of the system differs significantly from that found previously for the incompressible and subsonic analogs. Shocks form at the downstream boundaries of the embedded supersonic regions outside the central magnetic X-point and produce strong local current sheets which dissipate appreciable magnetic energy. Reconnection at the central X-point, which dominates the incompressible and subsonic systems, peaks later and has a smaller impact as M increases from 0.6 to 1.5. Similarly, correlation between the momentum and magnetic field begins significant growth later than in subsonic and incompressible flows. The shocks bound large compression regions, which dominate the wavenumber spectra of autocorrelations in mass density, velocity, and magnetic field. GRA

N91-12351# Wright Research Development Center, Wright-Patterson AFB, OH. Power Components Branch.
RYDBERG STATE STARK SPECTROSCOPY AND APPLICATIONS TO PLASMA DIAGNOSTICS Final Report, Oct. 1985 - Sep. 1989
James R. Shoemaker Mar. 1990 110 p
(AF Proj. 2301)
(AD-A225248; WRDC-TR-90-2027) Avail: NTIS HC/MF A06 CSCL 20/5

Rydberg state Stark spectroscopy of triplet and singlet helium was applied to measure the electric field profile in dc glow discharges. Stark splittings of triplet helium were used to map the field profile in the cathode sheath of a parallel plate discharge. Simulations of the observed spectra enabled the direct determination of the field gradient, hence the space charge density, in the sheath. The polarization dependence of the Stark effect was exploited to determine the field direction as well as magnitude (electronic field vector). Measurements of low electric fields (50 v/cm) were attempted by observing the linewidth of high Rydberg states (n 25) and applying standard line broadening approaches used in plasma diagnostics. However, it is shown that these approaches use approximations which are inappropriate for helium spectra and for the plasma conditions found in the glow discharges investigated. GRA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N91-12352 Durham Univ. (England).
ELECTRONIC STATES IN SEMICONDUCTOR SUPERLATTICES AND QUANTUM WELLS Ph.D. Thesis
D. T. Hughes 1989 182 p
Avail: Univ. Microfilms Order No. BRD-88656

How a complex bandstructure matching technique was developed which allows detailed investigations to be made of various low dimensional structures is explained. The method is then used to investigate interesting physical properties of quantum wells and superlattices. An exposition of the matching technique is provided, giving an indication of the numerical methods used for computational calculations. Evidence will then be given, in the form of a comparison between the present work and the experimental and theoretical results to be found in the literature,

of the efficacy of the method. A detailed description of results of calculations carried out on the valence band of AlAs/GaAs and AlGaAs/GaAs quantum wells will show how energy levels and wavefunction were calculated as well as giving an explanation of hybridization and anti-crossing effects. In order to extend the method to strained systems it is shown how strain can be incorporated into the model by simple empirical fits of calculated bulk properties to experiment. This method will be used to model two particular Si/Ge structures: a Ge(0.25)Si(0.75)/Si/Ge-(0.25)Si(0.75) quantum well as a Si4Ge4 superlattice. To allow a better comparison with experiment for the superlattice a description is given of a method for calculating optical matrix elements between superlattice states; and the results of such calculations are discussed. Dissert. Abstr.

N91-12353 Stanford Univ., CA.
CYCLIC VOLTAMMETRY OF SEMICONDUCTOR PHOTOELECTRODES Ph.D. Thesis
Patrick Gerard Santangelo 1990 322 p
Avail: Univ. Microfilms Order No. DA9024360

At present, no quantitative analytical solution or simulation framework exists for the cyclic voltammetric response at a semiconductor/liquid junction. A quantitative treatment of the cyclic voltammetric behavior of three ideal semiconductor electrode systems is described, and this behavior is verified experimentally for a specific semiconductor electrode/electrolyte combination. Theory is developed using an equivalent circuit formalism. Results of computer simulations are discussed for the following ideal semiconductor photoelectrode systems: (1) an electrode coated with a surface-attached electroactive reversible redox species; (2) an electrode in contact with freely diffusing electrochemically reversible redox species; and (3) a rotating disk electrode in contact with a reversible redox system. The discussion focuses on the shape and the position of the cyclic voltammogram as a function of the light intensity, voltage scan rate, and potential limits. A working curve formalism is also applied to each of the model semiconductor systems. A dimensionless parameter is generated for each working curve that determines the wave shape and position, and represents the ratio of the open circuit impedance of the semiconductor to the minimum total impedance for the faradaic and/or mass transport processes. Cyclic voltammograms were collected for the p-Si/cobaltocinium hexafluorophosphate/acetonitrile electrochemical system under sufficiently controlled experimental conditions to allow a quantitative comparison with theory. Results are evaluated in terms of the equivalent circuit model for data recorded under various illumination intensities, and scan rates. Dissert. Abstr.

N91-12354# China Nuclear Information Centre, Beijing.
THE CONTENT MEASUREMENT OF SUPERCONDUCTING PHASE FOR HIGH TEMPERATURE SUPERCONDUCTING OXIDE YBa2Cu3O(7-x)
Xin Li, Zhaoquan Liu, and Huanxing Li (Southwest Inst. of Physics, Sichuan, China) May 1989 5 p
(DE90-637631; CNIC-00283; SIP-0033) Avail: NTIS (US Sales Only) HC/MF A01

The magnetic conversion temperature, diamagnetism temperature point and the relations between the magnetic susceptibility and varying temperature of the YBa2Cu3O(7-x) oxide are measured by using a varied temperature vibrating magnetometer. The content of superconducting phase of the material is also calculated. DOE

N91-12355# Argonne National Lab., IL. Materials Science Div.
CRITICAL CURRENT DENSITIES IN NEUTRON IRRADIATED HIGH-T(SUB c) SINGLE CRYSTALS
H. W. Weber, F. M. Sauerzopf, H. P. Wiesinger, W. Kritscha (Atominstitut der Oesterreichischen Hochschulen, Vienna.), G. W. Crabtree, J. Z. Liu, M. C. Frischherz, and M. A. Kirk 1990 7 p Presented at the ICMC 1990 Topical Symposium on High Temperature Superconductors: Materials Aspects, Garmisch-Partenkirchen, Fed. Republic of Germany, 9-11 May 1990 Sponsored in part by Fonds zur Foerderung der Wissenschaftlichen Forschung, Vienna, Austria
(Contract W-31-109-eng-38)
(DE90-017794; CONF-900527-4; Rept-58906-00-105) Avail: NTIS HC/MF A02

Radiation damage and its effects on flux pinning and critical current densities in conventional superconductors have been investigated in much detail. In the case of fast neutron irradiation, the primary superconductive properties, such as the transition temperature (Tc), are not affected very much at relatively low fluences (approx. less than 10(exp 22)/sq m, E greater than 0.1 MeV) in general, but the critical current densities may either increase in low J sub c materials due to the introduction of new pinning centers, or increase because of a radiation induced increase of the upper critical field H(sub c2), or decrease due to an unfavorable interaction with the pre-irradiation defect structure. Concerning high temperature superconductors, neutron irradiation experiments on single crystals and subsequent magnetization measurements have consistently shown a significant broadening of the hysteretic magnetization curves and, thus, provided for (intrinsic) enhancements of critical current densities J sub c. Similar results on ceramics are attributed mainly to an increasing loss of weak link behavior with increasing neutron fluence. A systematic investigation is presented of fast neutron irradiation effects carried out in the fluence range from 2 x 10(exp 21) to 2 x 10(exp 22/sq m (E greater than 0.1 MeV) on two high quality single crystals of YBa2Cu3O(7-delta). Furthermore, results are presented of an irradiation experiment on a Bi2Sr2CaCu2O8 single crystal, which has demonstrated the feasibility of flux pinning temperatures and magnetic fields beyond the irreversibility line for the first time. DOE

N91-12356# Argonne National Lab., IL. Materials and Components Technology Div.
HEAT TRANSFER ISSUES IN THE FABRICATION AND OPERATION OF CERAMIC SUPERCONDUCTORS
J. R. Hull, T. M. Kuzay, and R. B. Poeppel 1990 5 p Presented at the ASME Winter Annual Meeting, Dallas, TX, 25-30 Nov. 1990
(Contract W-31-109-eng-38)
(DE90-017832; CONF-901194-3) Avail: NTIS HC/MF A01

Problems associated with the fabrication and operation of ceramic superconductors are discussed to suggest possible contributions from the heat transfer community that could advance high temperature superconductor technology. Specific fabrication issues include uniform temperature in sintering, speedup of directional solidification methods, uniform substrate temperatures for thin film fabrication, and process control in most wire and tape fabrication methods. Opportunity exists for analyses and novel designs in cryostat current leads, certain insulation problems, and other applications. Use of Be as a stabilizer is suggested in order to improve cryostability at 77 K. In addition, the use of SiC and novel heat transfer mechanisms is suggested for improvement of normal zone propagation velocity. DOE

N91-12357# North Carolina State Univ., Raleigh.
CARRIER COLLECTION AND SCATTERING IN QUANTUM WELL AND SUPERLATTICE DEVICES Final Report, 1 Apr. 1987 - 30 Apr. 1990
Robert M. Kolbas 30 Jun. 1990 7 p
(Contract DAAL03-87-K-0051)
(AD-A224619; ARO-24477.5-EL-SDI) Avail: NTIS HC/MF A02 CSCL 20/12

Significant progress has been made in understanding carrier collection and stimulated emission in ultra-thin semiconductor quantum wells. Continuous wave low threshold laser operation has been demonstrated with quantum wells as thin as one monolayer (3.5 A). A more complete theory of the scattering and collection of carriers near a quantum well has been proposed and shown to be quantitatively consistent with previous experiments and the unexpected experimental results (monolayer lasers) demonstrated in this program. It is shown that the spatial extent of the wave function rather than the well width is the more fundamental length parameter when considering the collection of carriers by a quantum well. The first time resolved data on phonon

assisted stimulated emission was demonstrated. The data are consistent with Holonyak's prediction of stimulated phonon emission. This could open up an entirely new class of electron-phonon-photon interactions in condensed matter. Other important results include: the first demonstration of laser action on a staggered (real space) transition; first tunneling through a bound state in a strained layer resonant tunneling device; and the demonstration that ultra-thin quantum wells can be preserved at elevated temperatures with a Ga overpressure. GRA

N91-12358# Arizona State Univ., Tempe.
GROWTH STUDIES OF CVD-MBE BY IN-SITU DIAGNOSTICS Annual Technical Report, 1 Jul. 1989 - 30 Jun. 1990
George N. Maracas, Timothy C. Steimle, and Krishan K. Bajaj 30 Jun. 1990 11 p
(Contract N00014-89-J-3120)
(AD-A224661) Avail: NTIS HC/MF A03 CSCL 20/2

This is a progress report for the first year of the DARPA - URI program, Growth Studies of CVD-MBE by in-situ Diagnostics. The goals of the program are to develop non-invasive, real time epitaxial growth monitoring techniques and combine them to gain an understanding of processes that occur during MBE growth from gas sources. These techniques are being developed and adapted to a commercially designed system (Vacuum Generators Inc.) to facilitate technology transfer out of the laboratory into industrial environments. Experimental results, when combined with a Monte Carlo simulation, should give some insight into the growth mechanisms that occur. Progress has been mostly in the construction of the in-situ diagnostic techniques and in modification of the gas source MBE. Several problems have been solved and we are now in a position to acquire data by three techniques; spectroscopic ellipsometry (SE), laser induced fluorescence (LIF) and RHEED. GRA

N91-12359# David Taylor Research Center, Bethesda, MD. Dept. of Ship Materials Engineering.
EFFECT OF ADDITIVES ON THE MORPHOLOGY AND SUPERCONDUCTIVITY OF YBa2Cu3O(6+x) CERAMIC SUPERCONDUCTORS Interim Report, Oct. 1989 - Sep. 1990
A. S. Rao (Cincinnati Univ., OH.), L. F. Aprigliano, O. P. Arora, and L. S. OConnor May 1990 35 p
(AD-A224734; DTRC-SME-89/102) Avail: NTIS HC/MF A03 CSCL 09/1

Superplastic deformation is being studied as a means to turn the new ceramic superconductors into useful Naval hardware. Superplastic deformation can occur when a small grained material is subjected to stress at temperatures that are at least a half of their melting point. The ceramic superconductors, of which YBa2Cu3O6+x is typical, require sintering treatments to create reasonably dense materials. However, sintering can result in a degree of grain growth that will not benefit superplastic deformation. To resolve the conflict of the need for full density with the need for a small grain size, the use of separate additives of Al2O3 and Ag2O particles to inhibit grain growth during sintering has been studied. GRA

N91-12360# City Coll. of the City Univ. of New York, NY. Dept. of Physics.
ULTRAFAST PHYSICS IN MICROSTRUCTURE AND ALLOY SYSTEMS Final Technical Report, 1 Dec. 1985 - 30 Nov. 1989
Robert Alfano 29 Jun. 1990 13 p
(Grant AF-AFOSR-0031-86; AF Proj. 2305)
(AD-A224762; AFOSR-90-0828TR) Avail: NTIS HC/MF A03 CSCL 20/12

The physics underlying ultrafast transient phenomena that occur in the semiconductor microstructures are summarized. (1) Nonequilibrium phonon effects on the energy relaxation and lifetime of photogenerated carriers in GaAs MQW; (2) Dependence of electron temperature on well width in AlInAs/GaInAs single quantum well; (3) Determination of band offsets in semiconductor heterolayer via optical transitions in ultrathin quantum wells; (4) Photogenerated of high density electron hole plasma energy relaxation and rapid expansion in CdSe; (5) Ultrafast photoluminescence kinetics from the magnetic semiconductor CdCrSe excited by femtosecond laser pulse; (6) Physics in semiconductor GaAs and GaSe under picosecond laser driven shock wave compression; (7) Optical transition and recombination lifetime in quasi-zero dimensional electron system in CdS(x)Se(1-x); (8) Picosecond dynamics of exciton dissociation by neutral carbon acceptors in GaAs quantum wells; (9) Determination of I-X mixing effects on the escape time of electrons in resonant state of GaAs/AlGaAs double barrier tunneling structures; (10) Determination of intervalley X sub 6 - Gamma sub 6 scattering time in GaAs by picosecond pump-probe infrared absorption spectroscopy; (11) Determination of the effective mass and energy minimum of the X7 satellite conduction band of GaAs; (12) Gamma-L Intervalley scattering rates in GaAs measured by femtosecond time resolved four wave mixing spectroscopy; (13) Hole dynamics in GaAs epilayer grown on Si substrate; and Electron dynamics in GaAs multiple quantum wells on Si. GRA

N91-12361# Utah Univ., Salt Lake City. Dept. of Physics.
HIGH FREQUENCY BEHAVIOR OF LONG AND SMALL JUNCTIONS Progress Report, 1 Dec. 1988 - 30 Nov. 1989
Orest G. Sympko 20 Jun. 1990 26 p
(Grant AF-AFOSR-0149-89; AF Proj. 2305)
(AD-A224763; AFOSR-90-0830TR) Avail: NTIS HC/MF A03 CSCL 20/12

Results are presented of studies on long Josephson junctions and on very small junctions. The long junctions are made out of NbN. Experiments were made on the lifetimes of fluxon states from 2 to 0.01 K; they are of importance to a fundamental understanding of tunneling and nucleation. Multifluxon resonances were observed and they are of interest to the application of long junctions as high frequency oscillators. Very small junctions, all NbN, were fabricated using a STM approach. Results show the Coulomb blockade, the Coulomb staircase, and the staircase, and the superconducting energy gap. The two types of junctions are being combined to observe Bloch oscillations. GRA

N91-12362# General Atomic Co., San Diego, CA.
HIGH TEMPERATURE CERAMIC SUPERCONDUCTORS Quarterly Progress Report No. 6, 1 Apr. - 30 Jun. 1990
A. Chen, K. C. Chen, D. M. Duggan, F. C. Montgomery, S. S. Pak, M. B. Maple, L. Paulius, and P. Tsai (California Univ., San Diego.) Jun. 1990 90 p
(Contract N00014-88-C-0714; GA Proj. 3850)
(AD-A224847; GA-C19465) Avail: NTIS HC/MF A05 CSCL 09/1

This is the sixth quarterly progress report on the work performed in the period from April 1, 1990 through June 30, 1990 on Office of Naval Research (ONR) Contract N00014-88-C-0714, entitled High-Temperature Ceramic Superconductors. The principal objectives of this program are (1) to demonstrate fabrication of high-temperature ceramic superconductors that can operate at or above 90 K with appropriate current density, Jc, in forms useful for application in resonant cavities, magnets, motors, sensors, computers, and other devices; and (2) to fabricate and demonstrate selected components made of these materials, including microwave cavities and magnetic shields. GRA

N91-12363# Brown Univ., Providence, RI. Dept. of Chemistry.
SYNTHESIS OF OXIDES CONTAINING TRANSITION METALS
Aaron Wold and Kirby Dwight 9 Jul. 1990 29 p Submitted for publication
(Contract N00014-89-J-1849)
(AD-A225032; TR-8) Avail: NTIS HC/MF A03 CSCL 20/2

Various techniques are described for the preparation of polycrystalline and single crystal samples of transition metal oxides. The importance of precursors in facilitating the formation of the desired product is discussed. The various problems encountered in the preparation of pure, homogeneous, uniform materials are related to the characterization of these compounds in order to properly describe their properties. GRA

N91-12364# California Univ., Los Angeles. Dept. of Chemistry.
GROWTH AND REACTIVITY OF CuCl ON Si(111) Technical Report No. 6, 1 Oct. 1989 - 31 May 1990
David K. Shuh, Robert M. Charatan, Richard S. Daley, and R. Stanley Williams 1 Jul. 1990 14 p Submitted for publication Sponsored in part by NSF
(Contract N00014-90-J-1178)
(AD-A225034) Avail: NTIS HC/MF A03 CSCL 09/1

Films of cuprous chloride (CuCl), a zinc-blende semiconductor lattice-matched to Si, were deposited by molecular beam epitaxy onto a room-temperature Si(111)-7x7 substrate and studied with surface-sensitive spectroscopies. Low-energy electron diffraction revealed an ordered 1x1 pattern at several monolayers coverage and Auger electron spectroscopy yielded an approximate Cu to Cl surface stoichiometry of one-to-one for as-deposited films. Ion scattering experiments indicated that the initial stage of CuCl growth involved Cl-Si bonding. Annealing the films initiated chemical reactions, which resulted in the loss of Cl and the formation of a Cu silicide. GRA

N91-12365# Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemistry.
MAGNETIC PROPERTIES OF THE ELECTRON-DOPED SUPERCONDUCTOR Nd(2-x)Ce(x)CuO(4-DELTA) Technical Report No. 52, 1 Jun. 1989 - 30 May 1990
G. Liang, J. Chen, M. Croft (Rutgers Univ., Piscataway, NJ.), K. V. Ramanujachary, and M. Greenblatt 1 Jun. 1990 11 p Submitted for publication
(Contract N00014-82-K-0317; NSF DMR-87-14072)
(AD-A225050) Avail: NTIS HC/MF A03 CSCL 09/1

Magnetic susceptibility and magnetization data are presented for Nd(2-x)Ce(x)CuO(4-sigma) system. The Nd-local moments are seen to be crucial in interpreting the magnetic response. Evidence for a pervasive diamagnetic component (onsetting near 24 K) in the low field response which is sharply maximized near x=0.16 is presented. GRA

N91-12366# Rutgers Univ., Piscataway, NJ. Dept. of Chemistry.
CHEMISTRY AND SUPERCONDUCTIVITY IN THALLIUM-BASED CUPRATES Technical Report No. 56, 1 Jun. 1989 - 30 May 1990
M. Greenblatt, S. Li, L. E. H. McMills, and K. V. Ramanujachary 1 Jun. 1990 29 p Submitted for publication
(Contract N00014-82-K-0317; NSF DMR-87-14072)
(AD-A225051) Avail: NTIS HC/MF A03 CSCL 09/1

Following the discoveries of high temperature superconductivity in the rare earth copper oxide systems at 40 K by Bednorz and Muller in 1986 and at 90 K by other researchers in 1987, Sheng and Hermann, in 1988, discovered superconductivity in the thallium-alkaline-earth copper oxide systems with critical temperatures as high as 120 K. All of the Tl-based compounds can be described by the general formula, Tl(m)A2Ca(n-1)CuO2(n+m+2), where m=1 or 2; n=5; A=Ba, Sr. For convenience, the names of these compounds are abbreviated as 2223 for TlBa2Ca2Cu3O10, where each number denotes the number of Tl, Ba(Sr), Ca and Cu ions per formula, respectively. The compounds with m=1 and m=2 are usually referred to as single and double Tl-O layered compounds, respectively. The highest superconducting transition temperature known so far was found in Tl2BaCa2Cu3O10 at 125 K. GRA

N91-12367# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering and Computer Science.
HIGH SPEED DEVICES BASED ON LATTICE MATCHED AND PSEUDOMORPHICALLY STRAINED QUANTUM WELLS FOR OPTOELECTRONIC INTEGRATED CIRCUITS Progress Report, 1 May - 31 Jul. 1990
Pallab Bhattacharya 31 Jul. 1990 8 p
(Contract N00014-90-J-1831)
(AD-A225052) Avail: NTIS HC/MF A02 CSCL 20/12

The main objectives are to develop InP-based lattice-matched and pseudomorphic quantum well materials using the MBE and MOMBE techniques, study their optical and electro-optic properties, and realize very high speed external modulators with them. The final stages are to realize OEICs with the lasers and modulators on the same chip. These objectives with both theory and experiments and the results are briefly described: Growth and optical characterization of InGaAs/InAlAs MQW; Electro-optic effect in pseudomorphic InGaAs/InAlAs/InP MQW; Tunneling and recombination times in quantum wells; and Broadband matching network for high frequency modulators. GRA

N91-12368# North Texas State Univ., Denton. Dept. of Physics.
TWO-PHOTON ABSORPTION CHARACTERIZATION OF HgCdTe Final Report, 28 Aug. 1987 - 27 Jun. 1990
Chris L. Littler and David G. Seiler 30 Jul. 1990 103 p
(Contract DAAB07-87-C-F094; DA Proj. 1L1-61102-A-31-B)
(AD-A225086; NV-90-14) Avail: NTIS HC/MF A06 CSCL 09/1

Magneto-Optical measurements of Hg(1-x)Cd(x)Te alloys have provided a new means of studying impurities and defects in this important II-VI material. Two-photon magnetoabsorption (TMPA) was used to accurately determine the temperature dependence of the energy gap of various HgCdTe alloys, revealing behavior that deviates from currently accepted models. In addition, magnetooptical techniques were used to detect the presence of both shallow and deep impurities/defects and accurately determine their activation energies, thus providing information necessary for understanding the electrical and optical properties of the material. GRA

N91-12369# Parke Mathematical Labs., Inc., Carlisle, MA.
GROWTH AND CHARACTERIZATION OF III-V EPITAXIAL FILMS Interim Report, Mar. 1988 - Mar. 1989
Alok Tripathi and Joseph A. Adamski Jan. 1990 73 p
(Contract F19628-88-C-0061; AF Proj. 4600)
(AD-A225087; RADC-TR-89-330) Avail: NTIS HC/MF A04 CSCL 09/1

The development of new or adaptation of existing methods for the preparation, growth and characterization of III-V electronic and optoelectronic materials for MOCVD technique was examined. Investigations were conducted on the growth of epitaxial layers using organometallic chemical vapor deposition method of selected III-V materials which are potentially useful for photonics and microwave devices. GRA

N91-12370# California Univ., Santa Barbara. Dept. of Electrical and Computer Engineering.
INVESTIGATION OF InP PROCESSING TECHNIQUES FOR DEVICE APPLICATIONS Final Technical Report, Feb. 1985 - Sep. 1987
James L. Merz Jan. 1990 31 p
(Contract F19628-85-K-0035; AF Proj. 2306)
(AD-A225090; RADC-TR-89-326) Avail: NTIS HC/MF A03 CSCL 20/2

The emphasis was strongly oriented towards the overall technology of InP for photonic and other device applications. These investigations include such important and diverse subjects as the use of Rutherford backscattering (RBS) to study the solid phase epitaxial growth of InP after amorphization by heavy implant doses, the formation of a novel insulator in InP for passivation, the metallurgy of the traditional AuGe/Ni/Au contact for n-type InP and an analysis of the annealing of such contacts during the short times involved in RTA, the use of electrochemical profiling techniques to determine non-uniform implant distributions into InP, and the diffusion of the deep Fe trap in semi-insulting InP substrates as a result of standard thermal treatments. Significant progress was made in all of these areas. GRA

N91-12371# Case Western Reserve Univ., Cleveland, OH. Dept. of Physics.
NANOMECHANICS OF THIN FILMS Annual Technical Report
Jun. 1990 9 p
(Contract N00014-89-J-1555)
(AD-A225180) Avail: NTIS HC/MF A02 CSCL 20/2

The work on the nanomechanics of thin films and microfibriles and interfaces is proceeding in a three-pronged approach, concentrating on deposited films and interfaces. The goal was to examine the structure property relations for mechanical properties in aluminum and aluminum oxide multilayers. Briefly the aluminum films have been deposited in various thicknesses in Ultra-High Vacuum (UHV) by evaporation from a W source and subsequently examined by AES, TEM and other surface analyses. For the mechanical data free standing aluminum films were formed by stripping in water from Victawer (R) edge coated thin glass slides following earlier published techniques. Thin aluminum films were deposited at room temperature by physical vapor deposition in UHV for mechanical testing. The film thickness ranged from 20 to 600 nm. Auger Electron Spectroscopy (AES) showed pure aluminum in the bulk, and a naturally formed layer of amorphous Al2O3, with a thickness of 3 to 5 nm, on the surface. Transmission Electron Microscopy (TEM) of these specimens showed the average grain size to vary proportionally with thickness. The samples ranged from 2 to 5 nm in length and 150 um in width. These Al films, like most deposited films, exhibited brittle behavior when strained uniaxially until fracture. It is also observed that the failure is intergranular. In an attempt to identify the mode of embrittlement, AES was used to investigate impurities at grain boundaries and the fracture edge. GRA

N91-12372# Pacific Northwest Lab., Richland, WA.
OPTIMIZED READOUT SYSTEM FOR COOLED OPTICALLY STIMULATED LUMINESCENCE
S. D. Miller and P. A. Eschbach Sep. 1990 19 p Presented at the 6th General Conference of the European Physical Society, Amsterdam, Netherlands, 3-7 Sep. 1990
(Contract DE-AC06-76RL-01830)
(DE91-000150; PNL-SA-18025; CONF-900903-1) Avail: NTIS HC/MF A03

Cooled Optically Stimulated Luminescence (COSL) in CaF2:Mn is an ionizing radiation dosimetry method recently developed at the Pacific Northwest Laboratory (PNL). In this method CaF2:Mn crystals irradiated by gamma radiation at room temperature are cooled to liquid nitrogen temperature (77 K), stimulated by ultraviolet laser light at 326 nm, and allowed to warm to room temperature. Light emission proportional to the gamma exposure occurs as the TLD warms from liquid nitrogen temperature to room temperature. The new method is an example of a highly sensitive phototransfer technique which could form the basis for future radiation dosimetry applications. Measurements to date have shown high potential for measuring gamma exposures in the range of 10 microR. The high sensitivity of the COSL technique is due in part to the larger quantum efficiency of radiative recombination at low temperatures and to the complete absence of the incandescent background associated with conventional thermoluminescent readout methods. Along with the potential for a system which is more sensitive than thermoluminescent readers, multiple COSL readouts can be performed with minimal reduction in the COSL intensity. The multiple readout capability can serve as a possible permanent dosimetry record, thus allowing the reanalysis of a questionable reading. In an attempt to optimize the sensitivity of the COSL method, a new readout system is being developed. DOE

N91-12373# Lawrence Livermore National Lab., CA.
SHOCK COMPACTION OF HIGH-T(SUB c) SUPERCONDUCTORS
S. T. Weir, W. J. Nellis, P. C. McCandless, W. F. Brocious, C. L. Seaman, E. A. Early, M. B. Maple, M. J. Kramer, Y. Syono, and M. Kikuchi (Tohoku Univ., Sendai, Japan) Sep. 1990 15 p Presented at the International Conference on Shock Wave and High-Strain-Rate Phenomena in Materials, San Diego, CA, 12-17 Aug. 1990 Submitted for publication
(Contracts W-7405-eng-48; W-7405-eng-82)
(DE91-000786; UCRL-JC-106066; CONF-900818-6) Avail: NTIS HC/MF A03

Results are presented for shock compaction experiments on high-(Tc) superconductors and describe the way in which shock consolidation addresses critical problems concerning the fabrication of high J(sub c) bulk superconductors. In particular, shock compaction experiments on YBa2Cu3O7 show that shock-induced defects can greatly increase intragranular critical current densities. The fabrication of crystallographically aligned Bi2Sr2CaCu2O8 samples by shock-compaction is also described. These experiments demonstrate the potential of the shock consolidation method as a means for fabricating bulk high-(Tc) superconductors having high critical current densities. DOE

N91-12374# Universiteit Twente, Enschede (Netherlands).
A CONTRIBUTION TO THE UNDERSTANDING OF ac LOSSES IN COMPOSITE SUPERCONDUCTORS Ph.D. Thesis
Robin Adrianus Hartmann 1989 178 p
(ISBN-90-9002966-4; ETN-90-97764) Copyright Avail: NTIS HC/MF A09

Current distribution, losses and voltage current relations of superconducting filaments, wires and cables, are discussed. Numerical models are derived for filaments for reducing Maxwell's equations to a Poisson equation in terms of the vectorpotential. Panel method and an iteration process is used for solving. Accurate expressions for the magnetization, voltage current relation and losses for circular, square and hollow filaments are derived. Non-zero filament radii do not appear to differ greatly from zero filament radii. For computation in cables, the constitutive relation of wires is assumed to be linear, and independant of place, time and local components of the electromagnetic field. Losses for a square cable appear to be smaller than losses for a circular cable, with equal perimeter, and placed in the same applied field. ESA

N91-12375# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Dienstleistungsbereich.
STRUCTURAL AND ELECTRONIC PROPERTIES OF DOPED a-Si(1-x)Ge(x): H ALLOYS GROWN WITH H-SOLUTION
Joerg Wind, Gerhard Kroetz, Vesselinka Petrova-Koch (Technische Univ., Munich, Germany, F.R.), Gerhard Mueller, and Peter P. Deimel 1989 3 p Presented at ICAST-13, Asheville, AL, 21-25 Aug. 1989
(Contract BMFT-13AS0022)
(MBB-Z-0251-89-PUB; ETN-90-97856) Avail: NTIS HC/MF A01

Doped a-Si(1-x)Ge(x):H films with improved transport properties were obtained by plasma decomposition of SiH4/GeH4/H2 mixtures. The beneficial effects of H-dilution are most pronounced in phosphorus doped alloys with comparable solid state concentrations of Si and Ge. Transmission electron microscopy and H-effusion measurements indicate that H-dilution favors the formation of more homogeneous alloys. ESA

N91-12376# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Physics.
POSITRON INTERACTIONS ON SOLID SURFACES AND AT BILAYERED STRUCTURES Ph.D. Thesis
Pekka A. Huttunen Finnish Academy of Technology 1990 37 p Sponsored by Emil Aaltonen Foundation
(Ph-166; ISBN-951-666-305-2; ISSN-0355-2721; ETN-90-97976)
Avail: NTIS HC/MF A03

A monoenergetic positron beam, operated under ultrahigh vacuum, was utilized to examine the interaction mechanisms of a positron at the vacuum-solid and the solid-solid interfaces. The positron surface processes and the underlying mechanisms are studied by monitoring their temperature and energy dependencies. Different fundamental aspects influencing positron motion at an interface of two materials are discussed. Positron energy loss mechanisms at the final stages of thermalization and thermal positron motion in the solids are studied. The positron diffusion is applied to extract defect profiles in heteroepitaxial structures. ESA

N91-12377# Air Force Systems Command, Wright-Patterson AFB, OH.
SINGLE-CRYSTAL GROWTH OF GOLD ON THE TUNGSTEN AUTOCATHODE
N. V. Mileshkina 11 Jul. 1990 12 p Transl. into ENGLISH

from Vestnik Leningradskogo Universiteta (USSR), no. 16, 1971 p 143-145
(AD-A225260; FTD-ID(RS)R-0582-90) Avail: NTIS HC/MF A03 CSCL 09/1

The conditions of Au crystal production on W field emitter were studied by the field emission microscope. The results have shown that microfield emitter increases field emission and its stability. The significance of transition layers on a metal substrate for crystallization is discussed. Wide use of method of autoelectronic microscopy both in research and in practical region requires together with use of high melting materials, decontaminated with heat treatment, expansion of wheel/circle of substances, suitable for use as autocathodes. Under ice, to a considerable degree, it was possible to achieve the complete auto-emission current from whiskers, grown from the vapors under high vacuum conditions. By this method together with the desorption by field are obtained the auto-emitter, which give the symmetrical picture of surface, and for the materials with the low melting point, in particular gold. Obtaining field emission current from the projections of low melting substances to the surface of point is proposed. GRA

N91-12378# Litton Systems, Inc., Charlotte, NC. Airtron Div.
CONTRACT CRYSTAL GROWTH AND FABRICATION SERVICES Quarterly Technical Report No. 5, May - Jul. 1990
J. E. Creamer, R. C. Acklin, and M. H. Randles 7 Aug. 1990 2 p
(Contract N00014-89-C-2222)
(AD-A225381) Avail: NTIS HC/MF A01 CSCL 20/2

This program is intended to give the scientists at the Naval Research Laboratory the ability to evaluate new solid state laser crystals. During the fifth quarter of this contract only one growth run was performed, the tenth since project start. The crystal requested and grown was Er, Tm:YAG. It was assumed that the distribution coefficients are unity and that the crystal composition will be the same as the melt. GRA

N91-12379# Massachusetts Inst. of Tech., Cambridge. Microsystems Technology Labs.
MECHANICAL PROPERTIES OF MICROELECTRONICS THIN FILMS: SILICON NITRIDE (Si3N4)
Fariborz Maseeh, Miles Arnone, and Stephen D. Senturia Oct. 1989 79 p LIMITED REPRODUCIBILITY: Availability: Document partially illegible
(Contract MDA972-88-K-0008; ARPA Order 6510)
(AD-A225394; VLSI-Memo-89-576) Avail: NTIS HC/MF A05 CSCL 09/1

Mechanical design of microfabricated devices requires knowledge of mechanical material properties. Thin film material properties are sensitively process dependent, and should therefore be organized accordingly. A relational database of material properties is under development as part of a general micro-electro-mechanical computer aided design environment. A computerized literature search through the published values for Silicon Nitride (Si3N4) properties under various processing conditions resulted in the following document. GRA

N91-12380# Massachusetts Inst. of Tech., Cambridge. Microsystems Technology Labs.
MECHANICAL PROPERTIES OF MICROELECTRONICS THIN FILMS: SILICON DIOXIDE (SiO2)
Fariborz Maseeh, Sean M. Gelston, and Stephen D. Senturia Oct. 1989 69 p
(Contract MDA972-88-K-0008; ARPA Order 6510)
(AD-A225395; VLSI-Memo-89-575) Avail: NTIS HC/MF A04 CSCL 09/1

Mechanical design of microfabricated devices requires knowledge of mechanical material properties. Thin film material properties are sensitively process dependent, and should therefore be organized accordingly. A relational database of material properties is under development as part of a general micro-electro-mechanical computer aided design (CAD) environment. A computerized literature search through the published values for silicon dioxide (SiO2) properties under various processing conditions resulted in the following document. GRA

N91-12381# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Abt. Korrosion und Kristallzucht.
DATA ACQUISITION FOR CONTROL AND REGULATION OF BRIDGMAN CRYSTAL GROWTH PLANT Thesis
Uwe Moeller May 1990 31 p In GERMAN; ENGLISH summary
(DLR-Mitt-90-11; ISSN-0176-7739; ETN-90-98049) Copyright Avail: NTIS HC/MF A03; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 13 Deutsche marks

The structure and principle of a data collection system for a Bridgeman control apparatus are described. Measuring instruments and control units from different producers were integrated in this system. With two computers it was possible to measure and modify important process parameters such as temperatures, cooling rate, gas pressure and pulling rate during the whole growth process. Measurements were made with this system to characterize time dependent convections in the melt. A totally automated crystal growth is possible. ESA

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N91-12382# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ILLUSTRATIONS FROM THE COLLECTION QUANTUM MECHANICS IN PICTURES
B. N. Zakharev and E. B. Plekhanov 1989 18 p In RUSSIAN; ENGLISH summary Presented at the 12th Few Body Conference, Vancouver, British Columbia, Jul. 1989 Submitted for publication
(DE90-631602; JINR-R-4-89-287) Avail: NTIS (US Sales Only) HC/MF A03

The graphs are given which elucidate the important quantum features: How variations of spectral parameters (positions of energy levels or R-matrix resonances and normalizing constants or reduced widths) affect the form of potentials; bound states embedded into the continuum spectrum and comparison of one-channel and two-channel models; resonance tunneling through a system of identical barriers and transfer to the limit of the infinite periodical lattice; and accumulation of errors in process of integration of differential equations in finite-difference approximation. The illustrations are accompanied by comments. DOE

N91-12383# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
INHOMOGENEOUS TWO-FLUID COSMOLOGIES WITH ELECTROMAGNETIC FIELD
M. A. S. Nobre (Universidade Federal do Rio de Janeiro, Brazil) and J. Lima 1988 27 p Prepared in cooperation with Universidade Federal do Rio Grande do Norte, Natal (Brazil); and Universidade Federal de Paraiba (Brazil)
(DE90-634868; CBPF-NF-072/88) Avail: NTIS (US Sales Only) HC/MF A03

A new class of exact expanding inhomogeneous solutions of the Einstein-Maxwell equations is derived. These solutions generalize the dust filled models found by Ruban and the Doroshkevich magnetic universes. In the most general case the cosmological constant is non-zero and the matter content is a mixture of two interacting perfect fluids plus a sourceless electromagnetic field. The influence of the field near the singularity and at the latter stages of the expansion is examined. A subclass

of the models approaches homogeneity and isotropy for large cosmological times. DOE

N91-12384# Bonn Univ. (Germany, F.R.). Inst. fuer Physik.
CLASSICAL AND QUANTUM MECHANICAL ASPECTS OF THE NONLINEAR DYNAMICS OF PERIODICALLY DRIVEN SYSTEMS Thesis [KLASSISCHE UND QUANTENMECHANISCHE ASPEKTE DER NICHTLINEAREN PERIODISCH GETRIBENER SYSTEME]
Heinz-Peter Breuer Apr. 1990 105 p In GERMAN
(Bonn-IR-90-14; ISSN-0172-8741; ETN-90-97904) Avail: NTIS HC/MF A06

The fundamentals of adiabatic motion and of the interconnected quantum holonomy in systems which are described through periodical time dependent Hamilton, operators, are discussed. A classical examination in the field of nonlinear dynamics of periodically driven, nonharmonic oscillators is conducted. ESA

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N91-12385*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
SPACE MARKET MODEL DEVELOPMENT PROJECT
Peter C. Bishop Jun. 1987 78 p
(Contract NCC9-16)
(NASA-CR-187249; NAS 1.26:187249) Avail: NTIS HC/MF A05 CSCL 05A

The objectives of the research program, Space Market Model Development Project, (Phase 1) were: (1) to study the need for business information in the commercial development of space; and (2) to propose a design for an information system to meet the identified needs. Three simultaneous research strategies were used in proceeding toward this goal: (1) to describe the space business information which currently exists; (2) to survey government and business representatives on the information they would like to have; and (3) to investigate the feasibility of generating new economical information about the space industry. Author

N91-12386# Navy Personnel Research and Development Center, San Diego, CA.
READINGS ON MANAGING ORGANIZATIONAL QUALITY Final Report, Apr. - Nov. 1989
Nida Backaitis, ed. (University of Southern California, Los Angeles.) and Harold H. Rosen, ed. May 1990 327 p Sponsored by Office of the Under Secretary of the Navy, Washington, DC
(AD-A224888; NPRDC-TN-90-19) Avail: NTIS HC/MF A15 CSCL 05/1

New management philosophies are examined which are helping to bring about the transformation of American industry and that are enabling firms to meet competitive challenges successfully with novel strategies. The new management philosophy is based on assumptions that better reflect the ground rules of today's global economy than do the assumptions upon which much of current management practice is based. The role is emphasized of leadership at various levels of the organization in bringing about effective organizational response to the new competitive challenge. It describes changes in policies, in organizational structure, in the management of relationships with customers and suppliers, and in the management of relationships within organizations that will help them to create and sustain competitive advantage. GRA

N91-12387# Defense Logistics Analysis Office, Alexandria, VA.
TQM TOOLS AND STUFF: THE INDOCTRINATION OF TYRONE NEWBLOOD
Jun. 1990 57 p
(AD-A225208) Avail: NTIS HC/MF A04 CSCL 05/1

This booklet is essentially a reprint of the Rome Air Development Center's Basic Training in TQM (Total Quality Management) Analysis Techniques. Thanks to the kind permission of Mr. Anthony Coppola, the author of the booklet, the DLA TQM office has been able to make very minor changes to his work to put a logistics flavor in this version . GRA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N91-12388 New York Univ., New York.
AN ARTIFICIAL INTELLIGENCE APPROACH TO THE DESIGN OF ONLINE INFORMATION RETRIEVAL SYSTEMS Ph.D. Thesis
Hsinchun Chen 1990 244 p
Avail: Univ. Microfilms Order No. DA9023796

An artificial intelligence approach is adopted in investigating the online information retrieval activity and in studying the design of online information retrieval systems. The initial approach was to investigate the interactions between the searcher and the retrieval system and the searcher and the reference librarian. The objective was to develop cognitive models of these processes that will provide a sound basis for incorporating search assistance into an online system. This research consisted of three stages: an empirical investigation stage, a system building stage, and a system testing stage. During the empirical investigation stage, two cognitive psychology based empirical studies were conducted in which the searcher/librarian and the searcher/system interactions were observed. Some important findings from these studies were derived: (1) a taxonomy of misconceptions users have about the subject area, the system and the classification scheme, (2) five online search strategies were developed, and (3) an empirically based process model for assisting searchers in refining their queries was developed. At the system building stage, a blackboard architecture was adopted for the prototype system where the proposed capabilities (alleviating searchers' misconceptions, selecting appropriate search strategies, and refining searchers' queries) were incorporated. This system was created using Lisp and Flavors. The system was tested against an existing online catalog in a laboratory experiment and the prototype system out-performed the existing online catalog in search recall and satisfaction level. This research suggests that a knowledge-based information retrieval system armed with the appropriate search heuristics, the knowledge about the subject area and the classification scheme, and the query refinement mechanisms can become more responsive, intelligent, and capable of providing interactive support of a variety of users. Dissert. Abstr.

N91-12389 Sussex Univ., Brighton (England).
A RELATIONAL DATABASE FOR CARTOGRAPHIC MAP DISPLAYS Ph.D. Thesis
Robert Daly 1988 294 p
Avail: Univ. Microfilms Order No. BRDX89823

The storage of cartographic data on computer database systems is presented. The design and implementation of a relational database system are described. The system is primarily intended to support the retrieval of map data with emphasis being placed on high accuracy, speed and flexibility. Data is expected in a

vectorized form and output is intended for color raster displays. The models which may be used to represent map data are examined and some interesting scale-free line and surface structures are presented. The section on data modelling discusses the contrasting requirements of line-based and area-based problems and the relative merits of regular and irregular representations. The model adopted as a general-purpose database incorporates an irregular vector structure, a scale-free quadtree-based surface structure, and a hierarchical feature description scheme. A grid partitioning is also considered necessary for indexing, for supporting enclosure and color infill operations. Within the database system, RDBASE, emphasis is placed on powerful indexing structures, high portability, integrated metadata, providing a bulk data storage facility for coordinate strings, and integrating structured query language (SQL) queries with a functional interface. Various indexing methods are described. Extensions to the B+tree method are presented which enable the handling of repeated values and combinations of attributes, and also support query optimization costing functions and unique identifier generation. Problems involving relational representations of network structures are used to identify the need for a functional interface to the database. The developed interface incorporates two levels: an efficient low level and a SQL-based high level. The latter incorporates an interesting implementation of the decomposition method for its query optimization. Dissert. Abstr.

N91-12390# Energy Technology Data Exchange, Oak Ridge, TN.
INTERNATIONAL ENERGY: SUBJECT THESAURUS
M. H. Raridon, ed. 1990 1068 p
(DE90-008750; ETDE/PUB-2) Avail: NTIS HC A99

The International Energy Subject Thesaurus contains the standard vocabulary to indexing terms (descriptors) developed and structured to build and maintain energy information databases. Involved in this cooperative task are (1) the technical staff of the USDOE Office of Scientific and Technical Information (OSTI) in cooperation with the member countries of the Energy Technology Data Exchange (ETDE), and (2) the International Nuclear Information System (INIS) staff representing the more than ninety countries and organizations recording and indexing information for the international nuclear information community. ETDE member countries are also members of the International Nuclear Information System (INIS). Nuclear information indexed and recorded for INIS by these ETDE member countries is also included in the ETDE Energy Data Base, and indexing terminology is therefore cooperatively standardized for use in both information systems. This structured vocabulary reflects the scope of international energy research, development, and technological programs and encompasses terminology derived not only from the basic sciences but also from the areas of energy resources, conservation, safety, environmental impact, and regulation. DOE

N91-12391 Maryland Univ., College Park.
THE ANALYSIS AND DESIGN OF CONCURRENCY USING BOX STRUCTURES Ph.D. Thesis
Shirley Ann Becker 1990 312 p
Avail: Univ. Microfilms Order No. DA9030848

This research extends the existing box structure theory by defining the syntactic signatures and syntax of concurrency so that a correct concurrent design is attainable. Concurrency is characterized in terms of process interaction, process synchronization, and process interruptions, so that syntactic signatures and syntactic descriptions of deterministic and non-deterministic concurrency can be defined. Guidelines for the analysis and design of new and existing concurrent system environments are presented. A white box structure is developed to describe potential concurrent designs that must be validated for correctness and completeness. Correctness and closure verification procedures are specified for deterministic concurrent system designs, and correctness and closure validation procedures were specified for non-deterministic concurrent system designs. A verification procedure for deterministic white box structures applied the abstract syntax method of verification. A validation procedure for non-deterministic white box structures defined the transformation of a white box structure into a petri-net graph for validation of correctness and closure properties associated with the petri-net. Performance issues associated with concurrent designs were also addressed so that the efficiency of alternate clear box designs could be assessed. An automated petri-net tool called P-NUT was used in our research to gather feedback about system performance. The box structure extensions were demonstrated in a case study on the analysis and design of concurrency in a complex system environment. The case study illustrated the application of the concurrency semantics and syntax as well as the correctness and closure process for deterministic and non-deterministic concurrent system designs. Dissert. Abstr.

N91-12392 East Anglia Univ., Norwich (England).
COMPARISON OF INFORMATION SYSTEMS DEFINITION METHODOLOGIES: AN ACTION RESEARCH, MULTIVIEW PERSPECTIVE Ph.D. Thesis
A. T. C. Wood-Harper 1989 246 p
Avail: Univ. Microfilms Order No. BRDX90011

The confusion in the choice of methodologies which support the definition of an information system prior to development and installation is identified. In order to alleviate this confusion a comparison of these methodologies is made and concludes: that no single approach is best or sufficient; that any approach should support organization activities and handle the data analysis perspective; and, that any method should make a contextual analysis of the environment. Consequently, this insight was used to identify generic approaches and then they were classified. After this classification a synthesis is made and this framework is expanded to a methodology called Multiview. For further clarity this methodology is then used for fieldwork consisting of six action research cases to accumulate the following lessons: the problem situation and the initial terms of reference; the problem solving team; action; methodology products and processes; and the theory of using the Multiview methodology for defining an information system. Finally, these lessons are used to make the following conclusions: that the methodology needed improvements; in defining an information system there is a minimum set of contingencies consisting of problem solver, the situation and the methodology; and also that the definition process can be considered as a social process which can be explained by social theories. From the above conclusions recommendations are made to improve the Multiview methodology, to research the contingencies, and to formulate a framework for the problem solver to create a unique method relevant to the situation.
Dissert. Abstr.

N91-12393# Ballistic Research Labs., Aberdeen Proving Ground, MD.
A DATABASE STORAGE SYSTEM AND THE SONIC DIGITIZER METHOD FOR RADIOGRAPHIC DATA REDUCTION USED BY THE PENETRATION MECHANICS BRANCH Memorandum Report, 1986 - 1989
Timothy G. Farrand Jun. 1990 102 p
(DA Proj. 1L1-62618-AH-80)
(AD-A224800; BRL-MR-3847) Avail: NTIS HC/MF A06 CSCL 14/2

A data reduction, storage, and analysis system is used by one team of the Penetration Mechanics Branch of the Terminal Ballistic Division of the Ballistic Research Laboratory. The reduction of penetrator/target interaction, as recorded via radiographs, and the analysis of the data in the computer data storage system are described in detail. GRA

N91-12394# Washington Univ., Saint Louis, MO. Center for Air Pollution Impact and Trend Analysi s.
ORGANIZATION, ACCESS, AND EXPLORATION FACILITIES FOR LARGE GEOPHYSICAL DATABASES: DATSAV SURFACE METEOROLOGICAL DATA Technical Report, 1 Oct. 1988 - 19 Sep. 1989
Rudolf B. Husar 19 Sep. 1989 44 p

(Contract F19628-87-K-0003; AF Proj. 7670)
(AD-A225132; GL-TR-89-0286; SR-1) Avail: NTIS HC/MF A03 CSCL 04/2

The overall objective of this project is to derive atmospheric aerosol climatology for the continental areas of the world. This is to be achieved by combining archived meteorological data observations, aerosol monitoring data, and general knowledge on the properties and behavior of aerosols. Exploration of meteorological data is a data intensive project. In this report database concepts and available data handling and manipulation techniques are described. Novel data handling and exploration facilities were applied to the meteorological data. Rationale and specific methods used to analyze European visibility data are presented. GRA

N91-12395# Naval Postgraduate School, Monterey, CA.
THE DESIGN OF A DL/I-TO-NETWORK INTERFACE FOR THE MULTI-MODEL, MULTI-LINGUAL, MULTI-BACKEND DATABASE SYSTEM M.S. Thesis
William A. Sheehan Dec. 1989 124 p
(AD-A225310) Avail: NTIS HC/MF A06 CSCL 12/7

There has been a tremendous growth in recent years in the use of data base management systems (DBMS) throughout the world. This has lead to efforts to increase the effectiveness and efficiency of systems designed to create and maintain large databases. The traditional approach has been to select a data model and its associated model-based data language and implement a database system based on that single model. The multi-model and multi-lingual database system (MM and MLDS) was designed to increase the functionality of database systems by allowing the use of multiple data models and several model-based languages on a single system. With this approach, the system could support a heterogeneous collection of databases, each based on the model most appropriate for the individual application requirements. The current implementation of MM and MLDS is restricted in cross-model accessing the available databases. This thesis is part of the effort to remove these restrictions, thereby allowing the databases based on given models to be accessed by database languages associated with different models. The goal of this thesis is to further increase the functionality of MM and MLDS by permitting a user knowledgeable only in a hierarchical-based data language (DL/I) to access and manipulate information in a network database, while strictly maintaining the integrity of the network model. GRA

N91-12396# Maryland Univ., College Park. Inst. for Advanced Computer Studies.
A DISTRIBUTED USER INFORMATION SYSTEM
Steven D. Miller, Scott Carson, and Leo Mark Mar. 1990 28 p
(AD-A225362; UMIACS-TR-90035; CS-TR-2424) Avail: NTIS HC/MF A03 CSCL 12/7

Current user information database technology within the DARPA/NSF Internet is adequate to deal with hundreds of hosts and a few thousand users. However, recent size estimates of the Internet indicate that its host population is now closer to one hundred thousand machines, and that its user population numbers around one million users. The current centralized technology cannot scale to accommodate such a large information base, and provides no facilities for the distribution or replication of information. This paper presents the design of a distributed, scalable user information database. GRA

N91-12397# Naval Postgraduate School, Monterey, CA. Dept. of Administrative Sciences.
OPTICAL STORAGE SYSTEM FOR SHIPBOARD SUPPLY DOCUMENTS M.S. Thesis
Richard C. Gottlick and Edwin A. Victoriano Dec. 1989 177 p
(AD-A225369) Avail: NTIS HC/MF A09 CSCL 20/6

This thesis attempts to find a better alternative to the manual storage of material issue and receipt documents on the Navy's aircraft carriers and submarine tenders. The objectives were to develop a system that would significantly reduce the labor time required to file the documents, reduce the required storage volume, increase file accuracy, and increase access to file information. Alternatives using current document storage technology were analyzed. A PC-based optical document storage and retrieval system is proposed as the optimum alternative. GRA

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N91-12398# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
TECHNOLOGICAL INNOVATION CENTERS IN BRAZIL: PERFORMANCE AND NEW DIRECTIONS M.S. Thesis [NUCLEOS DE INOVACAO TECNOLOGIA NO BRASIL: DESEMPENHO E NOVOS ENCAMINHAMENTOS]
Adriana PrestMattedi Apr. 1990 161 p In PORTUGUESE; ENGLISH summary
(INPE-5082-TDL/416) Avail: NTIS HC/MF A08

The Technological Innovation Centers (NITs) are analyzed as a structure which facilitates the interaction between research and production sectors. A theoretical basis was developed in order to understand the development of Brazil's technological policy, the processes of technological innovation and transfer, and some structures of interaction. A study about international experiences and a comparison between them and the NITs are also presented. In the empirical study, nine NITs were analyzed in order to examine their performance. It was observed that the NITs face structural problems and their present situation is far from the initial proposition. Despite these problems the main conclusion is that NITs are a valuable tool acting between technological demand and supply, enhancing the technological innovation. The NITs need to be restructured. Some suggestions are presented in order to increase the performance of the NITs. Author

N91-12399# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
TECHNOLOGICAL POLES IN BRAZIL: DEVELOPMENT AND NEW DIRECTIONS M.S. Thesis [POLOS TECNOLOGICOS NO BRASIL: DESEMPENHO E NOVOS ENCAMINHAMENTOS]
Monica Maria DeMarchi Apr. 1990 163 p In PORTUGUESE; ENGLISH summary
(INPE-5081-TDL/415) Avail: NTIS HC/MF A08

The performance of the Technological Poles mechanism and

similar structures is analyzed for example science parks. Initially, a literature search about the process of technological innovation and similar experiences in other countries was conducted. Subsequently, information was obtained through three distinct interview procedures to ascertain if Technological Poles are relevant to their region, how this mechanism helps the relation between professionalizing and research institutions with different companies, and how it helps the establishment of enterprises with technological basis. The development of each Pole was studied in conjunction with the factors behind this process. The role of the government was also investigated in each of the cases, and in particular its contribution to the build up of regional scientific and technological competency. Also investigated was the role of entrepreneurs, either science or business oriented. After this analysis some measures were proposed to contribute to the development of the Technological Poles mechanism. Author

N91-12400# Concordia Univ., Montreal (Quebec). Centre for System Research and Applied Epistemology.
RESEARCH ON COMPLEX DECISION MAKING, KNOWLEDGE REPRESENTATION, AND THE TRANSFER OF EXISTING SYSTEM TO ARI Final Report, Mar. 1982 - Sep. 1985
Gordon Pask Jun. 1990 33 p
(Contract MDA903-82-C-0055)
(AD-A225447; ARI-RN-90-35) Avail: NTIS HC/MF A03 CSCL 12/5

This report briefly describes the results of a program of research that focused on the conversion of a new technology into a form that is facile and generally transferable using a network of microprocessors. When the contract was awarded, the choice (at that time a very reasonable choice) of hardware was the 8-bit microprocessor and the Apple II microprocessor, augmented by standard peripheral equipment. The program suites, appropriate to these machines and a Corvus 20 Megabyte Disc, have been delivered, as originally specified. It is true a 16- or 32-bit technology would have been a better choice since obvious limitations and difficulties crop up with a smaller address space. However, the networking paradigm remains viable and may only be replaced by a multitasking system with very sophisticated display and control capabilities to exhibit the power of the systems to any user and render the computing organization transparent, as is required. The deliverables so far noted are CASTE (Course Assembly System and Tutorial Environment), THOUGHTSTICKER, and the Team Decision System (TDS), together with manually and computer-administered versions of a test for learning innovative and conceptual style, SPC2. In addition, documentation, source code, and various other documents are deliverable products.
GRA

88 SPACE SCIENCES (GENERAL)

N91-12401*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
MEASUREMENT AND CHARACTERIZATION OF THE ACCELERATION ENVIRONMENT ON BOARD THE SPACE STATION
Charles R. Baugher, ed. Washington Aug. 1990 669 p Workshop held in Guntersville, AL, 11-14 Aug. 1986; sponsored by Teledyne Brown Engineering
(Contract NAS8-36122)
(NASA-CP-3088; M-639; NAS 1.55:3088) Avail: NTIS HC/MF A99 CSCL 03A

This workshop provides a comprehensive overview of the work and status of each of these areas to provide a basis for establishing a systematic approach to the challenge of avoiding these difficulties during the Space Station era of materials experimentation. The discussions were arranged in the order of: the scientific understanding of the requirements for a micro-gravity environment, a history of acceleration measurements on spacecraft, the state of accelerometer technology, and the current understanding of the predicted Space Station environment. For individual titles, see N91-12402 through N91-12427.

N91-12402*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
OVERVIEW OF SPACE STATION **c18**
Claude C. Priest *In its* Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 25 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22B

An overview of the Space Station program for workshop participants is given. Covered here are overall program guidelines, international involvement, the present baseline configuration, and development plans for the coming year. Author

N91-12403*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DESIRABLE LIMITS OF ACCELERATIVE FORCES IN A SPACE-BASED MATERIALS PROCESSING FACILITY **c18**
Robert J. Naumann *In its* Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 18 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22B

There are three categories of accelerations to be encountered on orbiting spacecraft: (1) quasi-steady accelerations, caused by atmospheric drag or by gravity gradients, 10(exp -6) to 10(exp -7) g sub o; (2) transient accelerations, caused by movements of the astronauts, mass translocations, landing and departure of other spacecraft, etc.; and (3) oscillary accelerations, caused by running machinery (fans, pumps, generators). Steady accelerations cause continuing displacements; transients cause time-limited displacements. The important aspect is the area under the acceleration curve, measured over a certain time interval. Note that this quantity is not equivalent to a velocity because of friction effects. Transient motions are probably less important than steady accelerations because they only produce constant displacements. If the accelerative forces were not equal and opposite, the displacement would increase with time. A steady acceleration will produce an increasing velocity of a particle, but eventually an equilibrium value will be reached where drag and acceleration forces are equal. From then on, the velocity will remain constant, and the displacement will increase linearly with time. Author

N91-12404*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
IMPLICATIONS OF ACCELERATION ENVIRONMENTS ON SCALING MATERIALS PROCESSING IN SPACE TO PRODUCTION **c29**
Ken Demel *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 34 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22A

Some considerations regarding materials processing in space are covered from a commercial perspective. Key areas include power, proprietary data, operational requirements (including logistics), and also the center of gravity location, and control of that location with respect to materials processing payloads.
Author

N91-12405*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ACCELERATION EFFECTS OBSERVED IN OPTICAL DATA TAKEN IN SPACELAB 3 FES **c74**
James Trolinger, Ravindra Lal (Alabama A & M Univ., Huntsville.), and Rudy Ruff *In its* Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 25 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 20F

Optical instrumentation in the Fluids Experiment System (FES) is briefly described. Samples of the data produced by the schlieren and holography systems during the Spacelab 3 flight are then

presented with some of the holographic interferometry data being presented for the first time. Acceleration effects that can be observed in these data are discussed and the potential for using them as a basis for measurement is explored. This includes the tracking of deliberately introduced tracer particles and density gradients in the FES, the analysis of the existing concentration gradients, and a new fiber optic G-meter concept. Finally, some of the plans for acceleration measurement in the upcoming International Microgravity-1/FES are described. Author

N91-12406*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
MICROGRAVITY AND ITS EFFECTS ON RESIDUAL MOTIONS IN FLUIDS **c29**
J. Iwan D. Alexander and Charles A. Lundquist (Alabama Univ., Huntsville.) *In its* Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 11 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22A

The primary reason for conducting many materials science experiments in space is to minimize or eliminate undesirable effects that might result owing to convective motions in fluids that are driven by buoyancy effects. Of particular concern are the low frequency accelerations caused by the Earth's gravity gradient field, spacecraft attitude motions, and atmospheric drag. In order to gain a limited understanding of the effects of these accelerations, researchers calculated the Stokes' motion of a spherical particle in a fluid for various types of spacecraft attitudes. Researchers assessed the effect of slowly rotating the experimental system relative to the spacecraft in order to reduce the rate at which the particles accumulate against the container wall. Author

N91-12407*# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.).
THE MICROGRAVITY ENVIRONMENT OF THE D1 MISSION **c29**
H. Hamacher, U. Merbold (European Space Agency, Paris, France), and R. Jilg *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 24 p Previously announced in IAA as A87-15978 (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22A

Some characteristic features and results of D1 microgravity measurements are discussed as performed in the Material Science Double Rack (MSDR) and the Materials Science Double Rack for Experiment Modules and Apparatus (MEDEA). Starting with a brief review of the main potential disturbances, the payload aspects of interest to the analysis and the accelerometer measuring systems are described. The microgravity data are analyzed with respect to selected mission events such as thruster firings for attitude control, operations of Spacelab experiment facilities, vestibular experiments and crew activities. The origins are divided into orbit, vehicle, and experiment induced perturbations. It has been found that the microgravity-environment is dictated mainly by payload-induced perturbations. To reduce the microgravity-level, the design of some experiment facilities has to be improved by minimizing the number of moving parts, decoupling of disturbing units from experiment facilities, by taking damping measures, etc. In addition, strongly disturbing experiments and very sensitive investigations should be performed in separate mission phases. Author

N91-12408*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
LOW-g MEASUREMENTS BY NASA **c29**
Roger P. Chassay and Arthur Schwaniger *In its* Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 48 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22A

NASA has utilized low-g accelerometers on a variety of flights for over ten years. These flights have included aircraft parabolas, suborbital trajectories, and orbital missions. This large quantity of data has undergone only limited in-depth analyses. Highlights of this low-g data are presented along with brief discussion of the instruments used and the circumstances of the data collection. Author

N91-12409*# Draper (Charles Stark) Lab., Inc., Cambridge, MA.
PREDICTION AND RECONSTRUCTION OF ON-ORBIT ACCELERATION **c29**
Edward Bergmann *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 16 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22A

As the number of acceleration sensitive experiments to be carried on each Shuttle or Space Station mission increases, the requirement for either low-g environment or for accelerometry at each experiment location also increases. Preflight planning of such experiments in the past has not always included detailed analyses of the acceleration environment at the experiment location that had a serious impact on the experiment. Careful modeling of the mission activities and their effect on the experiment in many cases would have been beneficial to these experiments. In some cases, the experiment was not comprised, but insufficient instrumentation was available onboard to directly measure accelerations at the experiment location. The type of preflight modeling available to assist in experiment design and mission integration is described, as well as the use of that tool postflight to enhance flight data when sensors are not ideally suited to experiment analysis. Examples of recent shuttle flight experiments are presented. Author

N91-12410*# BGB, Inc., Huntsville, AL.
SPACELAB-3 LOW-g ACCELEROMETER DATA FROM THE FLUID EXPERIMENTS SYSTEM (FES) **c29**
Gary Arnett *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 46 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22A

The Fluids Experiment System (FES) flown aboard Spacelab 3 contained a Miniature Electrostatic Acceierometer (MESA). This accelerometer was purchased from Bell Aerospace, Textron and had three range (auto switching), bidirectional, three orthogonal axis capability. BGB, Inc. is in the process of examining the total mission data from this instrument. From these data, areas of interest are identified and related back to mission events. The basic format of the data for the total mission is root mean square (RMS), with two hours per plot. Author

N91-12411*# Teledyne Brown Engineering, Huntsville, AL.
MSL-2 ACCELEROMETER DATA RESULTS **c19**
Fred Henderson *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 29 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

The Materials Science Laboratory-2 (MSL-2) mission flew the Marshall Space Flight Center-developed Linear Triaxial Accelerometer (LTA) on the Space Transportation System (STS) 61-C Shuttle mission launched January 21, 1986. Flight data were analyzed to verify the quietness of the MSL carrier and to characterize the acceleration environment for future MSL users. The MSL was found to introduce no significant experiment acceleration; and the effects of crew treadmill exercise, Orbiter vernier engine firings, and other routine flight occurrences were established. The LTA was found to be well suited for measuring nominal to very quiet STS acceleration levels at frequencies below 50 Hz. Special processing was used to examine the low-frequency spectrum and to establish the effective rms amplitude associated with dominant frequencies. Author

N91-12412*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MECHANICAL ISOLATION FOR GRAVITY GRADIOMETERS **c19**
David Sonnabend *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 12 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

In principle, gravity gradiometers are immune to the effects of acceleration and vibrations. In real instruments, scale factor errors and structural compliance lead to undesired instrument outputs. Described here are the instruments and the fundamental sources of the problems, a calculation of the magnitude of the effects, a demonstration of the need for isolation in the Shuttle (indeed, almost any spacecraft), and the Jet Propulsion Laboratory eddy current isolation technique and its current development status. Author

N91-12413*# Textron Bell Aerospace Co., Belmont, CA.
THE MESA ACCELEROMETER FOR SPACE APPLICATION **c19**
William G. Lange and Robert W. Dietrich *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 28 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

An electrostatically suspended proof mass in the Miniature Electrostatic Accelerometer (MESA) is used to measure acceieration in the submicro-g range. Since no fixed mechanical suspension (such as springs or strings) is used, the constrainment scaling can be changed electrically after being placed in orbit. A single proof mass can sense accelerations in three axes simultaneously. It can survive high-g pyrotechnic-generated shocks and launch environments while unpowered. Author

N91-12414*# Payload Systems, Inc., Wellesley, MA.
A NEW ACCELEROMETER RECORDING SYSTEM FOR SHUTTLE USE **c19**
Byron Lichtenberg *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 18 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

Microgravity investigators are interested in enhancing the capabilities and improving the information return from accelerometers used in microgravity research. In addition to improving the accelerometer sensor, efforts should be directed towards using recent advances in microprocessor technology and system design techniques to improve sensor calibration and temperature compensation, online data display and analysis, and data reduction and information storage. Results from the above areas of investigation should be combined in an integrated design for a spaceflight microgravity accelerometer package. Author

N91-12415*# Honeywell, Inc., Minneapolis, MN. Systems and Research Center.
NEW ACCELEROMETERS UNDER DEVELOPMENT **c19**
Jerry Wald and M. Tehrani *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 20 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

The commercial viability of the Space Station requires that it provide a micro-g, or submicro-g environment to users. This represents significant improvement over existing systems. Attainment of the lowest micro-g levels requires isolation systems. Passive and active systems have been evaluated. Best performance is achieved using active approaches where accelerometer sensors close feedback loops. Two emerging accelerometer technologies are presented that have promise for meeting performance goals while achieving reductions of package size, weight, and power. The technologies addressed are Honeywell's design concept for an optical cavity locking accelerometer and the recent development of an integrated silicon accelerometer for government applications. Author

N91-12416*# Maryland Univ., College Park.
SUPERCONDUCTING SIX-AXIS ACCELEROMETER **c19**
H. J. Paik *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 14 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

A new superconducting accelerometer, capable of measuring both linear and angular accelerations, is under development at the University of Maryland. A single superconducting proof mass is magnetically levitated against gravity or any other proof force. Its relative positions and orientations with respect to the platform are monitored by six superconducting inductance bridges sharing a single amplifier, called the Superconducting Quantum Interference Device (SQUID). The six degrees of freedom, the three linear acceleration components and the three angular acceleration components, of the platform are measured simultaneously. In order to improve the linearity and the dynamic range of the instrument, the demodulated outputs of the SQUID are fed back to appropriate levitation coils so that the proof mass remains at the null position for all six inductance bridges. The expected intrinsic noise of the instrument is 4 x 10(exp -12)m s(exp -2) Hz(exp -1/2) for linear acceleration and 3 x 10(exp -11) rad s(exp -2) Hz(exp -1/2) for angular acceleration in 1-g environment. In 0-g, the linear acceleration sensitivity of the superconducting accelerometer could be improved by two orders of magnitude. The design and the operating principle of a laboratory prototype of the new instrument is discussed. Author

N91-12417*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PRESENTATION ON A SPACE ACCELERATION MEASUREMENT SYSTEM (SAMS) **c19**
Theodore L. Chase *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 20 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

The primary objective of the Space Acceleration Measurement Systems (SAMS) project is to provide an acceleration measurement system capable of serving a wide variety of space experiments. The design of the system being developed under this project takes into consideration requirements for experiments located in the middeck, in the orbiter bay, and in Spacelab. In addition to measuring, conditioning, and recording accelerations, the system will be capable of performing complex calculations and interactive control. The main components consist of a remote triaxial optical storage device. In operation, the triaxial sensor head produces output signals in response to acceleration inputs. These signals are preamplified, filtered and converted into digital data which is then transferred to optical memory. The system design is modular, facilitating both software and hardware upgrading as technology advances. Two complete acceleration measurement flight systems will be build and tested under this project. Author

N91-12418*# Teledyne Geotechnical, Dallas, TX.
ACQUISITION AND ANALYSIS OF ACCELEROMETER DATA **c19**
Keith R. Verges *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 32 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

Acceleration data reduction must be undertaken with a complete understanding of the physical process, the means by which the data are acquired, and finally, the calculations necessary to put the data into a meaningful format. Discussed here are the acceleration sensor requirements dictated by the measurements desired. Sensor noise, dynamic range, and linearity will be

determined from the physical parameters of the experiment. The digitizer requirements are discussed. Here the system from sensor to digital storage medium will be integrated, and rules of thumb for experiment duration, filter response, and number of bits are explained. Data reduction techniques after storage are also discussed. Time domain operations including decimating, digital filtering, and averaging are covered, as well as frequency domain methods, including windowing and the difference between power and amplitude spectra, and simple noise determination via coherence analysis. Finally, an example experiment using the Teledyne Geotech Model 44000 Seismometer to measure from 1 Hz to 10(exp -6) Hz is discussed. The sensor, data acquisition system, and example spectra are presented. Author

N91-12419*# Applied Technology Associates, Inc., Albuquerque, NM.

CHARACTERIZING PERFORMANCE OF ULTRA-SENSITIVE ACCELEROMETERS **c19**

Henry Sebesta *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 27 p (For primary document see N91-12401 03-88)

Avail: NTIS HC/MF A99 CSCL 14B

An overview is given of methodology and test results pertaining to the characterization of ultra sensitive accelerometers. Two issues are of primary concern. The terminology ultra sensitive accelerometer is used to imply instruments whose noise floors and resolution are at the state of the art. Hence, the typical approach of verifying an instrument's performance by measuring it with a yet higher quality instrument (or standard) is not practical. Secondly, it is difficult to find or create an environment with sufficiently low background acceleration. The typical laboratory acceleration levels will be at several orders of magnitude above the noise floor of the most sensitive accelerometers. Furthermore, this background must be treated as unknown since the best instrument available is the one to be tested. A test methodology was developed in which two or more like instruments are subjected to the same but unknown background acceleration. Appropriately selected spectral analysis techniques were used to separate the sensors' output spectra into coherent components and incoherent components. The coherent part corresponds to the background acceleration being measured by the sensors being tested. The incoherent part is attributed to sensor noise and data acquisition and processing noise. The method works well for estimating noise floors that are 40 to 50 dB below the motion applied to the test accelerometers. The accelerometers being tested are intended for use as feedback sensors in a system to actively stabilize an inertial guidance component test platform. Author

N91-12420*# EFFORT, Inc., Houston, TX.

FREE-FLOATING EXPERIMENTS IN ORBITER AND SPACE STATION Abstract Only **c29**

Owen K. Garriott *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 2 p (For primary document see N91-12401 03-88)

Avail: NTIS HC/MF A99 CSCL 22A

Manned spacecraft will never be free of acceleration perturbations due to necessary motions of crewmembers. However, in most cases, the perturbations can be minimized or even isolated from sensitive experiments when required. The principal disturbances and methods of isolation are described. As the crew moves about the spacecraft, no external forces are applied and the average acceleration remains near zero. External force will be exerted when jets are fired for spacecraft attitude control or translation, and these must be transferred to the microgravity experiments. Transitory acceleration and vibration are produced by crew and equipment. The most significant on Orbiter have been wall push-offs used for body translation within the spacecraft, the exercise conducted on a treadmill within the middeck area, closing doors of stowage compartments and the vibration of some machinery, such as a sample centrifuge. For short periods of perhaps a few minutes, crew and equipment motion can be largely inhibited, but not for much longer intervals. It may be necessary to mount especially sensitive experiments on an isolation table, which can greatly reduce the acceleration transferred to the experiment. Either weak mechanical springs or, even better, a computer-controlled electromagnetic suspension can be used to effectively insulate the table from vibration at frequencies above about 0.01 Hz. Another option is to free-float an experiment table within the spacecraft. All of the above-mentioned perturbations can be eliminated for some minutes if the entire experiment package is allowed to free-float within the spacecraft until a wall contact is made. Package acceleration levels should be maintainable below 10(exp -8) g sub o in this way. Author

N91-12421*# Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.).

MICROGRAVITY ACCELERATION MODELING FOR ORBITAL SYSTEMS Abstract Only **c29**

Walter Knabe and Charles R. Baugher, ed. (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.) *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 1 p (For primary document see N91-12401 03-88)

Avail: NTIS HC/MF A99 CSCL 22A

In view of the decisive importance of a disturbance-free environment on the Space Station, and on other orbital systems, for materials processing experiments, a theoretical and semi-experimental analysis of the acceleration environment to be expected on large orbiting spacecraft was undertaken. A unified model of such spacecraft cannot be established; therefore, a number of sub-models representing major components of typical large spacecraft must be investigated. In order to obtain experimental data of forces, a typical spacecraft - an engineering model of the Spacelab - was suspended on long ropes in a high-bay hanger, and equipped with a number of accelerometers. Active components on the Spacelab (fans, pumps, air conditioners, valves, levers) were operated, and astronautics moved boxes, drawers, sleds, and their own bodies. Generally speaking, the response of the Spacelab structure was very similar to the environment measured on Spacelabs SL-1, SL-2, and D-1. At frequencies in the broad range between 1 and about 100 Hz, acceleration peaks reached values of 10(exp -3) and 10(exp -2) g sub o, and even higher. Author

N91-12422*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

LOW-g PAYLOAD PLACEMENT CONSTRAINTS FOR SPACE STATION **c18**

Anita S. Carpenter and Stanley N. Carroll *In its* Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 14 p (For primary document see N91-12401 03-88)

Avail: NTIS HC/MF A99 CSCL 22B

Payloads onboard the Space Station will be subjected to a steady state acceleration level dominated by gravity gradient and aerodynamic drag forces. The g-level due to gravity gradient forces depends on the payload location relative to the center of mass, whereas the g-level due to aerodynamic drag may be assumed nearly constant throughout the Space Station. The vector of acceleration due to aerodynamic drag can always be broken down into three orthogonal components, in the direction opposite to the velocity vector, along the local vertical, and perpendicular to the orbit plane. It will be shown that the gravity gradient term has two components, which are orthogonal to one another. One component is along the local vertical and the other is perpendicular to the orbit plane. Thus, the combination of all components form an orthogonal triad of vectors. Addressed here are the payload location constraints to satisfy the requirements of 1 micro-g. The permissible locations are within an open-ended tube having an elliptical cross section, which is aligned with the velocity vector and centered on the system center of mass. Author

N91-12423*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE STATION DYNAMICS c18
Reg Berka *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 34 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22B

Structural dynamic characteristics and responses of the Space Station due to the natural and induced environment are discussed. Problems that are peculiar to the Space Station are also discussed. These factors lead to an overall acceleration environment that users may expect. This acceleration environment can be considered as a loading, as well as a disturbance environment. Author

N91-12424*# Boeing Aerospace Co., Seattle, WA.
SPACE STATION STRUCTURAL PERFORMANCE EXPERIMENT c18
Dick Gates *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 11 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22B

A flight experiment that could be used to measure Space Station dynamics during and after its assembly is discussed. By integrating sensors into the structure to measure its ambient dynamic responses, it will provide some information as to how it behaves during its evolution. The objectives of the experiment are to define a series of experiments to measure the dynamic responses due to disturbances to establish the experiment scenarios, and to identify the locations of the instrumentation that can be integrated into the structure. Researchers have also defined the Space Station resources that are required so that they can be included in the Mission Requirements Data Base (MRDB). They used the 16-flight-assembly scenario that was recommended by Rockwell as the baseline. Author

N91-12425*# Lockheed Missiles and Space Co., Sunnyvale, CA.
EFFECT OF SCIENCE LABORATORY CENTRIFUGE OF SPACE STATION ENVIRONMENT c18
Nancy Searby *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 17 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 22B

It is argued that it is essential to have a centrifuge operating during manned space station operations. Background information and a rationale for the research centrifuge are given. It is argued that we must provide a controlled acceleration environment for comparison with microgravity studies. The lack of control groups in previous studies throws into question whether the obseved effects were the result of microgravity or not. The centrifuge could be used to provide a 1-g environment to supply specimens free of launch effects for long-term studies. With the centrifuge, the specimens could be immediately transferred to microgravity without undergoing gradual acclimation. Also, the effects of artificial gravity on humans could be investigated. It is also argued that the presence of the centrifuge on the space station will not cause undo vibrations or other disturbing effects. Author

N91-12426*# Sundstrand Data Control, Inc., Redmond, WA.
NOISE POWER SPECTRAL DENSITY OF THE SUNDSTRAND QA-2000 ACCELEROMETER c19
Rex Peters, David Grindeland, and Charles R. Baugher, ed. (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.) *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 6 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

There are no good data on low frequency (less than 0.1 Hz) power spectral density (PSD) for the Q-Flex accelerometer. However, some preliminary stability measurements were made over periods of 12 to 24 hours and demonstrated stability less than 0.5 micro-g over greater than 12 hours. The test data appear to contain significant contributions from temperature variations at that level, so the true sensor contribution may be less than that. If what was seen could be construed as a true random process, it would correspond to about 0.1 micro-g rms over a bandwidth from 10(exp -5) Hz to about 1 Hz. Other studies of low frequency PSD in flexure accelerometers have indicated that material aging effects tend to approximate a first order Markhov process. If we combine such a model with the spectrum obtained at higher frequencies, it suggests the spectrum shown here as a conservative estimate of Q-Flex noise performance. Author

N91-12427*# Teledyne Brown Engineering, Huntsville, AL.
THE PERFECTLY IDEAL ACCELEROMETER c19
Ernst Stuhlinger *In* NASA, Marshall Space Flight Center, Measurement and Characterization of the Acceleration Environment on Board the Space Station Aug. 1990 20 p (For primary document see N91-12401 03-88)
Avail: NTIS HC/MF A99 CSCL 14B

Given here is a condensed version of the results and conclusions that developed during the Workshop. Upper limits of residual accelerations that can be tolerated during materials processes, presented as acceptable and as desirable limits, are shown. Designs and capabilities of various accelerometers, and their inherent problems, are compared. Results of acceleration measurements on Spacelab flights are summarized, and expected acceleration levels on the Space Station under various conditions are estimated. Author

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N91-12428 Cornell Univ., Ithaca, NY.
NEW VIEWS IN THE NEAR INFRARED: A FABRY-PEROT INTERFEROMETER FOR GALACTIC AND EXTRAGALACTIC ASTRONOMY Ph.D. Thesis
Thomas Michael Herbst 1990 170 p
Avail: Univ. Microfilms Order No. DA9027115

Two major observational studies undertaken with a new Fabry-Perot interferometer are described: near infrared spectroscopy of mass loss in young stellar objects (YSO), and molecular hydrogen line imaging of the infrared luminous galaxy NGC 6240. Also included is a thorough discussion of the design, development, and testing of the interferometer system. A survey of 15 pre-main-sequence stars in the Br(alpha) and Br(gamma) recombination lines of atomic hydrogen produced detections of both lines in most objects over a period of eleven months and gave strong evidence of uncorrelated variations of the line and continuum fluxes on short (week) timescales. The Br(alpha)/Br(gamma) line ratios of the later spectral-type stars are consistent with wind models with T(sub gas) approximately equal to 7000 K and M approximately less than 10(exp -7) solar mass/yr. A comparison of the mass loss rate derived from the infrared lines and millimeter CO observations strengthens the hypothesis that the winds may be partially or largely neutral in later type YSO's. Images of the nuclear region of NGC 6240 taken in the 2.122 microns, v = 1 - O S(1) quadrupole line of molecular hydrogen demonstrate that the line emission is extended and distinct from the two nuclei producing most of the continuum emission. A region approximately 2 sec southwest of the southern nucleus produces almost 20 percent of the total line radiation, yet has no detectable 2 micron continuum. The H2 lines are asymmetric, with very little emission on the short wavelength side of the line peaks. These results indicate that a global phenomenon, such as the dissipative collision of two disks of molecular material, is taking place. The presence of shock-excited material at the

same velocity throughout the central kpc of the galaxy and the asymmetry in the S(1) line profile support this conclusion.
Dissert. Abstr.

N91-12429 Boston Univ., MA.
THE LUMINOSITY SCALE OF RR LYRAE STARS USING THE BAADE-WESSELINK METHOD Ph.D. Thesis
Tianxing Liu 1990 338 p
Avail: Univ. Microfilms Order No. DA9017586

UBVRI and JK photometry and radial velocities were obtained for 13 field RR Lyrae stars covering a large range of metallicity. The surface brightness version of the Baade-Wesselink (B-W) method was applied to these stars to determine their absolute magnitudes (M sub v). Using static model atmospheres to provide color-temperature transformations, it was found that the RR Lyrae temperature scale can be relatively well defined by the color index V - K. The use of infrared photometry in a B-W analysis reduces the uncertainties because the sensitivity to gravity and metallicity is small. Complications in pulsational velocity determination also have small effects on the (M sub v) determination if the analysis is restricted to the phase interval where the temperature change is minimal. The results show a clear correlation between the luminosities of the RR Lyraes and their metallicities. The B-W analysis was extended to four RR Lyraes in globular cluster M4. The study indicates that an accuracy comparable to the field star (M sub v) determination can be achieved for cluster RR Lyraes. The mean value of (M sub v) for the four stars agree with the field star (M sub v) calibration appropriate to the cluster's metallicity, indicating no fundamental difference in the characteristics between field and cluster RR Lyraes. Based on the B-W study and other recent RR Lyrae (M sub v) estimates, it is concluded that: (1) the surface brightness technique when used with infrared photometry is a reliable method of determining (M sub v); (2) (M sub v) is correlated with (Fe/H); and (3) the slope of the (M sub v)-(Fe/H) relation is 0.2. Dissert. Abstr.

N91-12430 Manchester Univ. (England).
THE DETECTION OF ATMOSPHERIC VAPOURS USING OPTICAL WAVEGUIDE SENSORS Ph.D. Thesis
Norman Halliday 1988 212 p
Avail: Univ. Microfilms Order No. BRD-89261

The possibilities of using the intrinsic properties of optical fibre waveguides in the detection of atmospheric vapors are examined. The methods of gas detection used in gas analysis and alarm systems are reviewed in terms of their applicability as automatic field sensors. Exploitation of the intrinsic properties of optical fibres to produce a sensor offers the possibility of combining sensor and transmission link in a single distributed device with the potential advantage of increased contact between analyte and sensor. Systems are discussed that are analogous to absorption spectroscopy with extended path length and to internal reflectance spectroscopy. A simulation experiment is described which models the interaction of guided light with cladding material modified by analyte absorption. The system is used to assess the potential utility of possible cladding materials and to investigate the diffusion of analytes within the cladding by spatial filtering. The results obtained are compared with those obtained using coated fibers. The effects of changes in the optical properties of an environmental matrix on the transfer of light between two optical fibres in close proximity are examined in the context of producing a sensor for the capture of aerosol droplets. The degree of light transfer is found to be maximized at a particular refractive index of captured liquid dependent on the refractive indices of the waveguides and the geometry of the system. A mechanism is proposed for the transfer involving refraction through the liquid. Spectral analysis of the transferred light supports the proposed transfer mechanism and affords the capability of qualitative detection of sub microliter quantities of analyte. The transfer of light between waveguides is also modelled by a simulation experiment. The feasibility of constructing a practical detection system embodying the principles investigated is discussed. Dissert. Abstr.

N91-12431 Maryland Univ., College Park.
AN OPTICAL INVESTIGATION OF POWERFUL FAR-INFRARED GALAXIES Ph.D. Thesis
Lee Armus 1989 242 p
Avail: Univ. Microfilms Order No. DA9021473

The Infrared Astronomical Satellite (IRAS) surveyed over 96 percent of the sky at 12, 25, 60, and 100 microns. One of the most interesting results of the mission was the discovery of a class of powerful far-infrared galaxies (FIRGs) having both high far-infrared luminosities and large IR-to-optical flux ratios. The prototype FIRG's were modeled as galaxies undergoing large bursts of star formation, and/or galaxies harboring active galactic nuclei (AGN). To generate a large sample of GIRGs suitable for a statistical analysis of the ultimate source of their energies, a mid-far-infrared spectral shape criteria was applied to the IRAS database. This has resulted in the creation of an Infrared Color-Selected Sample of galaxies (ICSS galaxies), all having infrared spectral energy distributions similar to the prototype FIRGs. Spectra and/or images of a total of 71 ICSS galaxies are presented. Nearly 80 percent of the ICSS FIRGs exhibit disturbed continuum morphologies, many of which are strikingly similar to those produced in simulations of colliding disk galaxies. Spectroscopic evidence was found, in the form of stellar absorption and emission-lines, continuum colors, and nebular emission-lines, suggesting that the ICSS FIRG's have recently undergone episodes of enhanced circumnuclear star formation. Dissert. Abstr.

N91-12432 California Univ., Berkeley.
MEASUREMENTS OF THE SPECTRUM AND ANISOTROPY OF THE MILLIMETER WAVE BACKGROUND Ph.D. Thesis
Gary Mitchell Bernstein 1989 151 p
Avail: Univ. Microfilms Order No. DA9028740

The spectrum and anisotropy of the diffuse millimeter wave background was measured using a balloon-borne liquid-helium-cooled photometer. The spectrum is measured in five bands from 1 to 3 mm; an extensive search for systematic errors at the few percent level reveals two problems in the experiment: a short time fluctuation due to refraction from the liquid helium in the optics, and a long term drift attributable to contamination by emission from the warm end of the antenna. It is suggested that there is no longer any compelling evidence for deviations from a black body spectrum for the cosmic background radiation longward of 1 mm. The observed substantial excess flux at submillimeter wavelengths, if it has a greybody spectrum expected from dust emission, is isotropic to a few percent at angular scales of 20 deg or larger. This implies that the submillimeter excess is not produced in local astronomical sources, and must originate at substantial redshift. Dissert. Abstr.

N91-12433 California Univ., Berkeley.
THE DEVELOPMENT AND PERFORMANCE OF THE EXAM DETEC TOR TO SEARCH FOR EXTRAGALACTIC ANTIMATTER Ph.D. Thesis
Thomas Edward Coan 1989 130 p
Avail: Univ. Microfilms Order No. DA9028785

The design and development of a practical balloon borne instrument capable of detecting heavy (Z approximately equal to -26) antimatter in the cosmic rays are described. Emphasis is placed on describing the essential physics of the EXAM (extragalactic antimatter) instrument's individual detectors that make such a detection possible. In particular, it is shown that the responses from a plastic scintillator, a Cerenkov radiation detector, dielectric track detectors, and proportional drift tube arrays can be used to uniquely determine the speed, charge magnitude, and charge sign of a cosmic ray nucleus. This novel nonmagnetic detection scheme permits the construction of a relatively light weight (approximately 2,000 kg) detector with a large collecting power (approximately 10 sq m sr). The profound cosmological and elementary particle physics implications of the detection of just a single heavy antimatter nucleus are discussed in chapter one, along with arguments that imply that such a detected antinucleus must necessarily be extragalactic in origin. Chapters two through six describe the response of EXAM's individual

detectors to the passage of heavily ionizing charged particles. Chapter seven is an overview of the mechanical construction of the entire instrument. Details of the measurement of the light collection efficiency of EXAM's Cerenkov detector and primary scintillator using sea-level muons and how this will be used to assist in the flight data analysis are contained in chapter eight. This chapter also includes a description of the instrument's electronic configuration and its data acquisition system. Finally, there are two appendices summarizing some important mechanical stress calculations that were required to actually build the instrument. Dissert. Abstr.

N91-12434# Real Inst. y Observatorio de la Armada, San Fernando (Spain). Seccion de Astronomica.
CARLSBERG MERIDIAN CATALOGUE LA PALMA. NUMBER 4: OBSERVATIONS OF POSITIONS OF STARS AND PLANETS: MAY 1984 TO FEBRUARY 1988
1989 792 p Prepared in cooperation with Copenhagen Observatory, Denmark and Royal Greenwich Observatory, Herstmonceux, England
(ISBN-84-7469-048-X; ETN-90-98050) Avail: NTIS HC/MF A99

Positions and magnitudes of 50,929 stars, 41,110 proper motions, and 7,894 positions and magnitudes of 68 solar system objects obtained with the Carlsberg automatic meridian circle on La Palma during the years 1984 to 1987 are given. The positions of the stars are for the epoch of observation and the equinox J2000.0, and are in a system close to that of the FK5. The limiting magnitude is V = 13. The catalog mainly comprises the following stars: 21,328 international reference stars; 6,829 faint reference stars in the fields of about 200 benchmark radio sources; 9,209 F-stars within 100 pc; 5,665 G-K stars within 300 pc; 2,548 stars in nearby O-B associations; and 2,730 stars for the Hipparcos mission. Observations of Mars, Callisto, Saturn, Titan, Uranus, Neptune, and 62 minors planets are included. ESA

N91-12435# Royal Observatory, Edinburgh (Scotland). Infrared Telescope Unit.
UKIRT NEWSLETTER
Mar. 1989 18 p
(UKIRT-19; ISSN-0143-0599; ETN-90-97964) Avail: NTIS HC/MF A03

A full color image of the Orion nebula observed with the United Kingdom Infrared Telescope (UKIRT) is presented which reveals the presence of a dense young cluster of about 500 young stars. A history of the development of the strictly telescope part of the United Kingdom Infrared Telescope (UKIRT) is given. Early and present day performances are compared. Improvements in telescope optics, dome seeing, pointing, dynamic performance, thermal infrared performance and autoguiding are discussed. Publications based on UKIRT observations are listed. An analysis of UKIRT observing time, information on service observing and the instruments available (supported by VAX/ADAM software) are presented. ESA

N91-12436# Royal Observatory, Edinburgh (Scotland). Infrared Telescope Unit.
UKIRT NEWSLETTER
Sep. 1989 16 p
(UKIRT-20; ISSN-0143-0599; ETN-90-97965) Avail: NTIS HC/MF A03

The following discussions are included: staff movements, new telescope control system, infrared camera (IRCAM) developments, Cooled Grating Spectrometer (GCS) 4 for the United Kingdom Infrared Telescope (UKIRT) data storage, limitations imposed by 1 to 2.5 microns sky emission on IR spectroscopy observations with GCS 2, scientific publications based on UKIRT observations, distribution of UKIRT time by scientific category, UKIRT user committee membership, service observing, and instruments available. ESA

N91-12437*# National Aeronautics and Space Administration, Washington, DC.
THE HUBBLE SPACE TELESCOPE OPTICAL SYSTEMS FAILURE REPORT
Nov. 1990 107 p Original contains color illustrations
(NASA-TM-103443; NAS 1.15:103443) Avail: NTIS HC/MF A06; 3 functional color pages CSCL 03A

The findings of the Hubble Space Telescope Optical Systems Board of Investigation are reported. The Board was formed to determine the cause of the flaw in the telescope, how it occurred, and why it was not detected before launch. The Board conducted its investigation to include interviews with personnel involved in the fabrication and test of the telescope, review of documentation, and analysis and test of the equipment used in the fabrication of the telescope's mirrors. The investigation proved that the primary mirror was made in the wrong shape (a 0.4-wave rms wavefront error at 632.8 nm). The primary mirror was manufactured by the Perkin-Elmer Corporation (Hughes Danbury Optical Systems, Inc.). The critical optics used as a template in shaping the mirror, the reflective null corrector (RNC), consisted of two small mirrors and a lens. This unit had been preserved by the manufacturer exactly as it was during the manufacture of the mirror. When the Board measured the RNC, the lens was incorrectly spaced from the mirrors. Calculations of the effect of such displacement on the primary mirror show that the measured amount, 1.3 mm, accounts in detail for the amount and character of the observed image blurring. No verification of the reflective null corrector's dimensions was carried out by Perkin-Elmer after the original assembly. There were, however, clear indications of the problem from auxiliary optical tests made at the time. A special optical unit called an inverse null corrector, designed to mimic the reflection from a perfect primary mirror, was built and used to align the apparatus; when so used, it clearly showed the error in the reflective null corrector. A second null corrector was used to measure the vertex radius of the finished primary mirror. It, too, clearly showed the error in the primary mirror. Both indicators of error were discounted at the time as being themselves flawed. The Perkin-Elmer plan for fabricating the primary mirror placed complete reliance on the reflective null corrector as the only test to be used in both manufacturing and verifying the mirror's surface with the required precision. This methodology should have alerted NASA management to the fragility of the process and the possibility of gross error. Such errors had been seen in other telescope programs, yet no independent tests were planned, although some simple tests to protect against major error were considered and rejected. During the critical time period, there was great concern about cost and schedule, which further inhibited consideration of independent tests. Author

N91-11985*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Space Physics and Astrophysics Section.
TECHNICAL CONSIDERATIONS ON USING THE LARGE NANCAY RADIO TELESCOPE FOR SETI
S. Gulkis, F. Biraud, J. Heidmann, and J. Tarter (California Univ., Berkeley.) *In its* The Telecommunications and Data Acquisition Report 15 Aug. 1990 p 152-160 (For primary document see N91-11973 03-32)
Avail: NTIS HC/MF A08 CSCL 03A

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

N91-12438 Colorado Univ., Boulder.
DYNAMICAL MODELING OF COLLISIONAL TRANSPORT PROCESSES IN PLANETARY RINGS: NARROW RINGS, MULTI-COMPONENT RINGS, AND SATELLITE PERTURBATIONS Ph.D. Thesis
Thomas George Brophy 1989 159 p
Avail: Univ. Microfilms Order No. DA9024817

A model kinetic equation is solved numerically for a flattened Keplerian disk using a phase-space fluid method which models the particle transport as a Markov process. This method simulates the dynamical evolution of planetary rings which is governed by kinetic equations. This phase-space fluid method avoids the prohibitive complexity of the moment equations by solving the kinetic equation directly, and is much faster than N-body methods. We generalize the Krook collision operator for the case of the two-component kinetic equations. Two component rings are simulated in which the large particles are eight times as massive as the small particles and the small particles are effectively massless. Single-component rings are also simulated. The calculations resolve the unconstrained edges of these rings in detail and show sharpening of the two-component edges. A reduced phase-space fluid method is derived to solve the kinetic equations for simulating two-dimensional, nonaxisymmetric perturbed rings. The accuracy of the reduced phase-space method is extensively verified. Both wakes and resonances are simulated in rings perturbed gravitationally by a nearby satellite. Angular momentum flux reversal in wakes is verified. Flux reversal is also shown to occur at isolated resonance locations. Density peaks which may be described by large nonlinearity parameter, q, are found to be limited by the presence of velocity dispersion in both wakes and resonances. The density structures at isolated resonances are forced, damped, and non-linear two-dimensional standing waves. These waves can explain, and thus are the probable cause of, many observed sharp density features at resonance locations in planetary rings. Dissert. Abstr.

N91-12439 Princeton Univ., NJ.
THE FIRST THREE MICROSECONDS: COSMIC STRINGS, AXIONS AND MAGNETIC FIELDS Ph.D. Thesis
Jean Maurice Quashnock 1990 106 p
Avail: Univ. Microfilms Order No. DA9024541

The dynamics of local cosmic strings are discussed in chapter one. The gravitational back-reaction problem and its relevance to kinks and cusps, as well as its implications for cosmic string networks, gravitational radiation and large-scale structure formation, are treated in depth. Cusps survive the backreaction. The decay time of a kink of size l, t(l)(sub decay) is found to be approximately ((gamma (sub kink)(G)(mu)) exp(-1))l where gamma (sub kink) is approximately 50. Kink decay times together with millisecond pulsar timing measurements yield an upper limit to the string tension, namely, G mu is less than 6 x 10 (exp -5). This is far from ruling out the cosmic string scenario of galaxy formation. The issue of divergences in global strings is resolved in chapter two, using a renormalization technique similar to that first used by Dirac for the classical electron. It is found that the motion of large global strings is very similar to that of local strings, and that as a consequence the axion mass is greater than 10(exp -3) eV. This lower bound is marginally inconsistent with an upper bound derived from SN1987a constraints; effectively the axion is ruled out as a cosmologically important dark matter candidate. The electrodynamics of the quantum chromodynamics (QCD) phase transition are dealt with in chapter three, which is assumed to be first order. Because of temperature gradients during the nucleation of hadron bubbles in the quark-gluon plasma, a thermoelectric Biermann battery is created during the transition. It is found that magnetic fields of size 10(exp -17) gauss will be present on A.U. scales during the epoch of galaxy formation. These fields may be the seeds required by dynamo theories of galactic magnetic fields. Dissert. Abstr.

N91-12440 Arizona State Univ., Tempe.
THE NH3 AND NH2 ABUNDANCES IN COMET HALLEY Ph.D. Thesis
Stephen Christopher Tegler 1989 109 p
Avail: Univ. Microfilms Order No. DA9018531

A comparison between observations and a model of the NH2 distribution in the coma of comet Halley is presented. The three-dimensional model utilizes Monte Carlo techniques relevant to high production rate comets and molecular species distributed close to the nucleus. The model is calculated specifically for the NH2 molecule in the coma of comet Halley at the time of the Giotto spacecraft encounter. The model represents coma physics more accurately than exospheric models previously used in the study of NH2 in that time dependent gas production rates, anisotropic ejection of molecules from the nuclear surface, and neutral-neutral molecular collisions are included. For comet Halley collisions have significant effects on the model out to a distance of several thousand kilometers from the nucleus, well within the range of ground-based long-slit spectra. In the model H2O molecules are the collision targets for both the NH2 molecule and its parent molecule. The NH2 distribution on the plane of the sky is calculated for the date of the Giotto encounter and is compared with the NH2 surface brightness distributions of comet Halley obtained from the Cerro Tololo InterAmerican Observatory. The relative contribution of CHON particles, N2H4, and NH2CH3 to the observed NH2 is discussed. The model described above, constrained by observational data, provides an improved determination of the abundance ratio NH3/H2O, a sensitive indicator of the physical and chemical conditions in the comet forming regions of the protosolar nebula. Dissert. Abstr.

N91-12441 California Univ., Santa Cruz.
A STUDY OF THE STRUCTURE AND KINEMATICS OF THE NARROW-LINE REGION IN SEYFERT GALAXIES Ph.D. Thesis
Sylvain Veilleux 1989 291 p
Avail: Univ. Microfilms Order No. DA9021413

The results of a high resolution study of the narrow emission line profiles of 16 Seyfert galaxies are presented. It is shown that the line profile parameters published in earlier low resolution studies are sometimes strongly influenced by resolution effects. In spite of these important systematic errors, many of the results derived from low resolution data are confirmed in the high resolution data. The narrow line profiles of Seyfert galaxies have a stronger base relative to core than a Gaussian. Most of the emission lines present a blueward asymmetry in the lower portion of their profile. In some galaxies, the line widths and/or line asymmetries are correlated with the ionization potential and/or critical density of the lines. There is a weak correlation between the line asymmetry and the dust content of the narrow line region (NLR). The large scatter in this relation, the absence of a similar correlation in Seyfert 1 to 1.5 galaxies, and the presence of a blue asymmetry in galaxies with dustfree line-emitting regions suggest that dust obscuration is not the only mechanism responsible for the line asymmetry in active galaxies. An optically-thick disk close to the nucleus is proposed as the other source of line asymmetry. An important result is that the host galaxy is probably playing a role in the kinematics of some of the gas in the NLR. A multicomponent model of the NLR is proposed to explain these results.
Dissert. Abstr.

N91-12442 Massachusetts Univ., Amherst.
CO LINE EMISSION FROM CLUMPY MOLECULAR CLOUDS: THE CASE OF ORION Ph.D. Thesis
Jan Alejandro Tauber 1990 482 p
Avail: Univ. Microfilms Order No. DA9022750

It is generally believed that molecular clouds are clumpy. In clumpy molecular clouds the large scale spatial distribution of the emission from the ionized, neutral, and molecular carbon species is significantly different than it would be in a cloud with a smooth density distribution. Thus it should be possible to derive some general properties of the clumps (i.e., size, volume filling factor, kinematics, etc.) by observing these species, even if individual clumps are not spatially resolved. A receiver was built capable of observing both the J = 3 yields 2 transition of (12)CO and (13)CO and the (3)P sub 1 yields (3)P sub o transition of neutral atomic carbon, and a filterbank of novel design that acts as its backend. This instrument was used to obtain a map of (12)CO J = 3 yields 2 in the Orion A region. The observed line shapes, and a comparison of the intensity of this line to that of the J = 1 yields 0 transition, strongly suggests that this region is clumpy, that a kinetic temperature gradient exists within each clump, and that the source of the heating is situated on the surface of the cloud. A model was developed of an edge-heated clumpy molecular cloud

that takes into account the chemical and thermal effects of the UV photons on the density and temperature structure of the clumps. It is shown that this model can reproduce the observed (12)CO intensities and line ratios in the region, and is in qualitative agreement with other characteristic features observed in this and other similar regions. Dissert. Abstr.

N91-12443 California Univ., Santa Cruz.
EVOLUTIONARY SCENARIOS FOR LOW-MASS STARS AND SUBSTELLAR BROWN DWARFS Ph.D. Thesis
Guy Scott Stringfellow 1989 287 p
Avail: Univ. Microfilms Order No. DA9021412

Several investigations into the evolution of very low mass (VLM) stars and substellar brown dwarfs (SBDs) were conducted. The first is a numerical simulation of the evolution of optically visible protostars accreting mass from a disk. It is suggested that rotation, not deuterium burning, is simultaneously responsible for forming the disk and optically revealing the central protostar. It is assumed that the accretion energy can be radiated by either a boundary layer (BL) or the protostellar photosphere, or some combination thereof. The BL mechanism fits the observations better and indicates that T Tauri stars are accreting. Second, the evolution of isolated VLM stars and SBDs is computed for two sets of atmospheric (grain) opacities. These results are compared with other recent models and observations. The influence of a white dwarf's radiation flux on the evolution of a SBD companion is considered. Larger opacities significantly increase the radii of SBDs, but the thermal bath does not. The thermal bath increases substantially the SBD temperature and luminosity at a given age. Inclusion of both effects increases the mass range of the possible SBD companion of G29-38 significantly over previous work. As a step toward improving the equation of state for VLM stars and SBDs, internal energies obtained from Monte Carlo simulations of the One-Component Plasma are re-examined. Dissert. Abstr.

N91-12444 Massachusetts Univ., Amherst.
GAS DYNAMICS IN INTERACTING AND MERGING GALAXIES Ph.D. Thesis
Kevin Mark Olson 1990 107 p
Avail: Univ. Microfilms Order No. DA9022730

A three dimensional model of the dynamics of gas clouds in interacting galaxies is developed. The gas clouds move under the combined gravitational influence of two galaxies passing close to each other. By performing a multipole expansion of the gravitational field the effects of self-gravity within a galaxy are included. This allows the case to be modeled in which the two galaxies merge. The gas clouds are allowed to interact with one another by colliding. They either coalesce to form a larger cloud or are disrupted, depending on their relative kinetic energy as compared to the total gravitational binding energy of the two-cloud system. Various cases are considered by varying such parameters as impact parameter, inclination of the gaseous disk of a galaxy to the orbital plane of the two, interacting galaxies, relative velocity of the galaxies, the mass ratio of the galaxies, and the presence of gas in the second galaxy. As the strength of the interaction increases the more disturbed the interstellar medium becomes. The clouds collide at an increased rate and with larger velocities so that the fraction of collisions which disrupt the clouds rises as the strength of the interaction increases. Since interacting galaxies are observed to have elevated star formation rates, it is concluded that the star formation induced by the interaction of two galaxies is related to the high velocity, disruptive cloud-cloud collisions. Dissert. Abstr.

N91-12445 California Univ., Santa Cruz.
DYNAMICS OF GRAVITATIONAL SYSTEMS: GLOBULAR CLUSTERS AND DARK MATTER HALOS Ph.D. Thesis
Kap-Soo Oh 1989 275 p
Avail: Univ. Microfilms Order No. DA9023052

The evolution of globular clusters is investigated using a combination of the modified Fokker-Plank equation and numerical integrations of N-body systems. The orbit-averaged diffusion coefficients in the inner region of the cluster and integrate the orbits of the stars in the outer region are use. The King-Michie distribution is adopted as an initial model. Both isotropic and anisotropic cases are examined. The following was found. There is no orbital phase dependence of tidal radius of clusters in eccentric orbits. The number of stars with retrograde orbits is similar to the number with prograde orbits inside the tidal radius for the isotropic case. Escape rates are similar to those found in previous work for the isotropic case but considerably smaller in the anisotropic case. Disk shocking is very efficient isotropizing the orbits of stars in the outer region of the cluster in the anisotropic case. The response of dark matter galactic halos during the dissipational collapse of the baryonic matter are investigated. N-body simulations are used with the total mass and z-component of angular momentum conserved. Then the baryonic matter is forced to contract, forming the final luminous components of the galaxy. Both slow and fast growth of the luminous components are considered. Relatively flat rotation curves are easily obtained for reasonable values of the free parameters. There is no significant difference between slow collapse and fast collapse for all these results. Dissert. Abstr.

N91-12446 Massachusetts Univ., Amherst.
A MULTI-TRANSITION STUDY OF THE CYCLIC MOLECULE CYCLOPROPENYLIDENE (C3H2) IN THE GALAXY Ph.D. Thesis
Suzanne C. Madden 1990 297 p
Avail: Univ. Microfilms Order No. DA9022711

Results of multi-transition observations and modeling of the hydrocarbon ring molecule cyclopropenylidene (C3H2) are reported. From a survey of the 1(sub 10)-1(sub 01) (18 GHz) and 2(sub 12)-1(sub 01) (85 GHz) transitions including cold, dark clouds, giant molecular clouds, the envelope of a carbon star, and diffuse clouds. Up to 10 transitions of C3H2 ranging in wavelength from 1.3 cm to 1.3 mm were observed in the dark clouds L1498, L134N, B335 and toward several positions in TMC-1. The Large Velocity Gradient (LVG) approximation was used to model the observations. Optical depth values of C3H2, estimated from 13-CC2H2 observations, are necessary to constrain the results since the range in excitation energies of the observed C3H2 transitions does not contrast sufficiently. The molecular hydrogen density in TMC-1 is estimated to be 3.7 x 10(exp 4)/cu cm, while the fractional abundance of C3H2 relative to H2 is 5.7 x 10(exp -9). Previous estimates assuming LTE conditions overestimate the abundance of C3H2. The abundance in the ridge component in Orion is estimated to be approximately 8 x 10(exp -10). Gas phase chemical models can reproduce the high C3H2 abundance found in dark clouds under assumptions such as steady state conditions with (C)/(O)/ is greater than 1.0, conditions of earlier evolutionary time, or optimistic rate coefficients. However, large deuteration ratios (0.05 to 0.15) create difficulties for gas phase models.
Dissert. Abstr.

N91-12447 Notre Dame Univ., IN.
NUCLEAR AND ASTROPHYSICAL IMPLICATIONS OF PROTON CAPTURE ON Si-28 Ph.D. Thesis
Stephen M. Graff 1990 180 p
Avail: Univ. Microfilms Order No. DA9022953

The absolute cross section for proton capture on Si-28 was determined for the proton energy range from .370 to 2.925 MeV. Strengths of proton resonances at, Ep = .371, .724, 1.380, 1.652, 2.083, 2.880 MeV, were determined. In addition cross sections for direct capture to the ground and first excited states of P-29 were determined. The spectroscopic factors from the direct capture measurements are compared with DWBA spectroscopic factors from transfer reactions. A correction for the deformation of P-29 in the spherical direct capture model is also discussed. The resonance strengths and cross sections measured here are used to calculate the stellar reaction rate for Si-28(rho,gamma)P-29. The conflict on the strength of the resonance at Ep = .371 MeV in the literature is resolved. A method for measuring the stoichiometry of oxide targets using direct capture techniques and a calibrated target is presented. Estimates are presented for the usefulness of this technique in determining oxygen content of unknown materials. Dissert. Abstr.

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N91-12448 Colorado Univ., Boulder.
SEASONAL CHANGES IN THE ABUNDANCE AND VERTICAL DISTRIBUTION OF WATER VAPOR IN THE ATMOSPHERE OF MARS Ph.D. Thesis
Helen Mavis Hart 1989 193 p
Avail: Univ. Microfilms Order No. DA9024831

The Viking Orbiter Mars Atmospheric Water Detector measured reflected solar radiance in three absorption regions and two continuum regions within the 1.4 micron band of water vapor. The three atmospheric transmittances obtained from the measurements are compared with the computation of transmittance for a model atmosphere to determine water vapor column abundance, effective pressure, and effective temperature. A multi-layered single-scattering model was used to demonstrate that, for cases where the atmosphere is relatively dust-free, scattering has a minor effect on atmospheric transmittance. Vertical non-homogeneity of the atmosphere can be ignored if the atmospheric temperature can be determined to within +/- 15 K. In cases where scattering and vertical non-homogeneity can be ignored, an atmospheric model consisting of a single homogeneous, dust-free layer is used to calculate abundance and effective pressure. Uncertainties in abundance and pressure due to measurement noise and to uncertainty in temperature are calculated explicitly. Abundance varies strongly with longitude; but this variation is likely to be due entirely to longitudinal variation in effective pressure. Effective pressure is used to parameterize the vertical distribution. Seasonal changes in effective pressure in northern equatorial latitudes indicate that in spring, water vapor is distributed uniformly with altitude; by summer, abundance increases by 50 percent and the added water vapor is confined within the lower layers of the atmosphere. The most likely physical mechanism for confinement is trapping by saturation at low altitudes. Changes in abundance in southern latitudes are consistent with cross-equatorial transport by the solstice Hadley circulation. Dissert. Abstr.

N91-12449 Arizona Univ., Tucson.
AN OBSERVATIONAL COMPARISON OF MERCURY AND THE MOON Ph.D. Thesis
Ann Louise Sprague 1990 146 p
Avail: Univ. Microfilms Order No. DA9025086

Observations of the neutral sodium (Na) and neutral potassium (K) atoms in the tenuous atmospheres of the Moon and Mercury were made, analyzed, and interpreted. An atmospheric number density of approximately 300 times more Na and approximately 100 times more K are observed at Mercury than at the Moon. This is not consistent with a meteoritic source for these constituents unless losses and recycling are very different. Potassium observations in the lunar atmosphere indicate fewer accommodated atoms than expected from thermalization of the extended component through gas-surface interactions. A mechanism for redistributing the thermal and non-thermal populations is presented. Thermal infrared observations between 7.5 and 12.5 microns were made at both bodies in an attempt to gain understanding of the relationship of the surfaces to the alkali atmospheres. Mercury was found to have a surface composition at three locations more felsic than that of the lunar south-polar highlands. Spectral indications of high alkali feldspar were observed. One mafic location on Mercury's surface was determined. Calculations using a grain-boundary and regolith diffusion model have shown that the differences in abundances of Na and K and the ratios of Na/K at both bodies can be explained by a supply of atoms diffusing upward through the sub-surface materials over geologic time. Enhancements in K seen at the longitude of Caloris and the antipodal point of up to five and four respectively, point to a sub-surface source for at least part of the tenuous alkali atmosphere at Mercury. Dissert. Abstr.

N91-12450 Arizona Univ., Tucson.
NONRADIAL OSCILLATIONS OF SATURN: IMPLICATIONS FOR RING SYSTEM STRUCTURE Ph.D. Thesis
Mark Scott Marley 1990 132 p
Avail: Univ. Microfilms Order No. DA9022115

Numerous wave and gap features observed in Voyager data of Saturn's rings are produced by resonances between the orbital frequencies of known external satellites and ring particle orbits. The possibility that other, currently unassociated, ring features are generated by perturbations on ring participle orbits are investigated. These perturbations are produced by non-axisymmetric gravitational fields resulting from acoustic oscillation modes of the planet. The frequencies of Saturnian low degree fundamental mode (f-mode) oscillations are calculated for a variety of Saturn interior models. Corrections for rotation, oblateness, and possible differential rotation were applied. Only the low degree f-modes are found to have frequencies and likely wave amplitudes in the range necessary to produce gap or wave features in the rings. The calculated positions of outer Lindblad resonances (OLR) for the degree l = 2,3,4, and 5 sectoral f-modes of a single Saturn model lie near four previously unassociated C-ring features. These features are the Maxwell gap and three waves identified as being forced at either OLR or inner vertical resonances. The outer vertical resonance (OVR) of the l = 5, m = 4 mode also overlaps the location of a wave which may be forced at either an OVR or an inner Lindblad resonance. Four other similar wave features, however, cannot be explained by oscillation mode resonances. This failure is the principal inadequacy of the hypothesis. Other observed properties of the wave features; however, are consistent with the proposed forcing including their azimuthal wavenumbers, m, and the variation of amplitude with proposed oscillation mode degree. Planetary oscillation amplitudes of approximately 1 m are required for gap opening; wave amplitudes of approximately 10 cm are required for density wave production. The C-ring thus serves as a very sensitive f-mode detector. Dissert. Abstr.

N91-12451 Oxford Univ. (England).
LONG-LIVED EDDIES IN THE ATMOSPHERE OF JUPITER Ph.D. Thesis
S. R. Lewis 1988 257 p
Avail: Univ. Microfilms Order No. BRD-89428

A quasi-geostrophic numerical model is developed to investigate several hypotheses advanced to explain the origin, stability and persistence of Jupiter's long-lived eddies. The model explicitly includes forcing and dissipation processes which are vital for the long-term maintenance of eddies. Experiments are conducted with three different sets of boundary conditions which represent the laboratory internally heated annulus experiment, shallow atmospheric flows vertically confined to the two model levels, and deep atmospheric flows. The quasi-geostrophic annulus analogue reproduces the regimes of flow observed in the laboratory, and allows the dynamics of baroclinic eddies to be examined and compared with other Jovian eddy hypotheses. The atmospheric models demonstrate many of the processes of quasi-two-dimensional geostrophic turbulence. Coherent, strong eddies are found in the deep model where they are trapped to the upper levels. Baroclinic eddies are generated as the result of zonal flow instabilities, and may be maintained against dissipation by zonal mean diabatic heating. Compact, modon solutions are also shown to be stable in the deep model, in the absence of non-conservative effects. Additional feedback is required to maintain eddies of modon form against dissipation, and may increase the compactness of baroclinic eddies. Solitary, persistent eddies may be produced in both the annulus analogue and deep atmospheric model. Interactions with transients erode the diabatically maintained features in contrast to the reinforcing effect of modon coalescence. The motion of passive tracers is suggested as one means of inferring the direction of transient transport of potential vorticity. A laboratory experiment is conducted and compared with examples from a quasi-geostrophic numerical advection model. Dissert. Abstr.

N91-12452 Arizona Univ., Tucson.
SATURN'S ATMOSPHERE IN THE VISIBLE AND NEAR INFRARED, 1986-1990 Ph.D. Thesis
Erich Karkoschka 1990 242 p
Avail: Univ. Microfilms Order No. DA9028148

Observations of Saturn's atmosphere are presented in the visible and near infrared including 4 hydrogen quadrupole lines, 17 methane absorption bands ranging over three orders of magnitude in absorption strength, an ammonia absorption band, and the absolute calibrated continuum spectrum. All observations have complete coverage of Saturn's disk, in latitude as well as in center-to-limb position. This data set gives a quite complete description of Saturn's atmosphere at the spacial resolution of ground base observations. An atmospheric model is given which fits all observations within estimated errors. It has clear gas at the top of the atmosphere, an extended haze layer and a reflective cloud at the bottom. Pressure levels and the haze optical depth were determined as a function of latitude. The single scattering albedo spectrum of the particles (most likely ammonia ice crystals) is also given for each latitude. Dissert. Abstr.

N91-12453 Essex Univ., Colchester (England).
THE SMALL SYSTEM MODELLING OF THE POLLUTED PLANETARY BOUNDARY LAYER Ph.D. Thesis
Angus Robert MacKenzie 1989 214 p
Avail: Univ. Microfilms Order No. BRD-89973

The transport, chemical transformation, emission, and deposition of trace constituents of the Planetary Boundary Layer (PBL) is described. Simplified schemes for describing this behavior are discussed and the idea of a small systems approach put forward. This approach hypothesizes that there are regions of the total theory domain which are sufficiently independent of other areas that they can be described by restricted domain models. Explicit recognition of output applicability is required if the model is to be used successfully. Two small systems models, describing volatile nitrate aerosol kinetics and surface ozone in an urban plume, are used as case studies to test the method. Ammonium nitrate aerosol is shown to have a significant kinetic restraint on the attainment of the dissociation equilibrium in the PBL. This will have important repercussions on the spatial distribution of nitrate deposition. The effect of input parameters on incremental ozone concentrations within urban plumes are quantified using a factorial experimental design procedure. Considerable non-linear interations are observed between parameters. The extreme ozone increments measured in the field are not simulated by the model used, and the variation of neither structural nor input parameters adjusts the model sufficiently to account for these large incremental ozone effects. This is a pragmatic justification of the small systems approach, and its legitimacy is made more apparent when it is viewed as an intermediary expression in a hierarchy of idealizational statements concerning the PBL. The classical rate law for a bimolecular process can be concretized using a set of correctional functions to give the small system model, the Lagrangian model, the Eulerian, and the (fully-concretized) continuity equation at various points. The hierarchy of air pollution models and the applicability of their output is thus made clear. Dissert. Abstr.

N91-12454# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Fisica dello Spazio Interplanetario.
THE VISIBLE CHANNEL OF OMEGA-VIMS, MARS-94
V. Formisano, G. Bellucci, G. Chionchio, E. Amata, P. Baldetti, A. Carusi, F. Capaccioni, A. Coradini, P. Cerrone, and A. Adriani (Istituto di Fisica dell Atmosfera, Rome, Italy) et al Jan. 1990 59 p
(IFSI-90-1; ETN-90-97784) Avail: NTIS HC/MF A04

Instrumentation designed to support remote sensing of planetary surfaces by an infrared multispectral imager is described. The OMEGA (French acronym for observatory for mineralogy, water, ice and activity) - VIMS (Visual and Infrared Mapping Spectrometer) infrared spectrometer is described in detail. The French and American built spectrometer is designed to map the Martian surface, analyze surface mineralogy, chemical composition, and recognize geological units at a regional level while carried on the Soviet mission to Mars. The visible channel of the OMEGA-VIMS spectrometer is discussed in detail. It is designed to extend the mapping capability, of the spectrometer towards short wavelengths. ESA

N91-12455# European Space Agency, Paris (France).
AN OLD LEGEND - NEW SCIENCE - ULYSSES: SOME QUESTIONS ON ULYSSES AND ITS PAYLOAD ANSWERED
Richard G. Marsden, ed. and Norman Longdon, ed. Jul. 1990 33 p Original contains color illustrations
(ESA-BR-71; ISBN-92-9092-063-7; ETN-90-97998) Copyright
Avail: NTIS HC/MF A03; EPD, ESTEC, Noordwijk, Netherlands, HC 20 Dutch guilders

An overview of the Ulysses mission to investigate how the Sun's environment changes from the equator towards the poles is presented. Scientific objectives, the long transit period and aspects of the Jupiter phase are discussed. Scientific instruments on board are described relating to solar wind, magnetic fields, energetic particles and cosmic rays, solar flare x rays and gamma ray bursts, interstellar neutral gas, cosmic dust, and radio and plasma waves. The reception and distribution of data is discussed. ESA

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N91-12456*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
CLIMATE IMPACT OF SOLAR VARIABILITY
Kenneth H. Schatten, ed. and Albert Arking, ed. Washington Aug. 1990 367 p Conference held in Greenbelt, MD, 24-27 Apr. 1990
(NASA-CP-3086; Rept-90B00129; NAS 1.55:3086) Avail: NTIS HC/MF A16 CSCL 03B

The conference on The Climate Impact of Solar Variability, was held at Goddard Space Flight Center from April 24 to 27, 1990. In recent years they developed a renewed interest in the potential effects of increasing greenhouse gases on climate. Carbon dioxide, methane, nitrous oxide, and the chlorofluorocarbons have been increasing at rates that could significantly change climate. There is considerable uncertainty over the magnitude of this anthropogenic change. The climate system is very complex, with feedback processes that are not fully understood. Moreover, there are two sources of natural climate variability (volcanic aerosols and solar variability) added to the anthropogenic changes which may confuse our interpretation of the observed temperature record. Thus, if we could understand the climatic impact of the natural variability, it would aid our interpretation and understanding of man-made climate changes. For individual titles, see N91-12457 through N91-12506.

N91-12457*# Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.
STUDIES OF SOLAR TYPE STARS Abstract Only.
Sallie Baliunas and Robert Jastrow (Dartmouth Coll., Hanover, NH.) *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 7 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

Satellite observations show a change of 0.1 percent in solar irradiance over the past decade. The question arises as to whether larger changes in irradiance may occur over century time scales. Researchers approached this question by looking at changes in surface magnetism, since the satellite observations also show that irradiance and surface magnetism are correlated. To obtain information on possible variations in surface magnetism over century-long intervals, researchers looked at records of surface magnetism spanning up to 20 years for a sample of 74 stars of solar type, i.e., of similar age and mass to the sun. The histories

of these stars, observed in random phases of their long-term variability, give a snapshot at any one time of the behavior of a solar-type star over long periods of time. Evidence on Maunder Minimum phases and levels of magnetic activity in these solar-type stars are compared with information on solar magnetism. Implications for solar irradiance changes are discussed. Author

N91-12458*# Lowell Observatory, Flagstaff, AZ.
SOME INSIGHTS ON SOLAR VARIABILITY FROM PRECISION STELLAR ASTRONOMICAL PHOTOMETRY
G. W. Lockwood and B. A. Skiff *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 8-15 Sponsored in part by AF; and by Lowell Research Fund (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

At Lowell Observatory, precision photoelectric photometry was directed toward the study of solar variability and the variability of sun-like stars beginning in 1949 and continuing until now. The ubiquity and range of low-level variability, including some that appears to be cyclic, among solar-type stars shows that recent solar variability may be unusual only in its present restraint. Author

N91-12459*# California State Univ., Northridge. Dept. of Physics and Astronomy.
A PROGRAM OF PHOTOMETRIC MEASUREMENTS OF SOLAR IRRADIANCE FLUCTUATIONS FROM GROUND-BASED OBSERVATIONS
G. A. Chapman, A. D. Herzog, J. K. Lawrence, and S. R. Walton *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 16-20 (For primary document see N91-12456 03-92)
(Grants NAG5-1219; NSF ATM-88-17634)
Avail: NTIS HC/MF A16 CSCL 03B

Photometric observations of the sun have been carried out at the San Fernando Observatory since early 1985. Since 1986, observations have been obtained at two wavelengths in order to separately measure the contributions of sunspots and bright facular to solar irradiance variations. Researchers believe that the contributions of sunspots can be measured to an accuracy of about plus or minus 30 ppm. The effect of faculae is much less certain, with uncertainties in the range of plus or minus 300 ppm. The larger uncertainty for faculae reflects both the greater difficulty in measuring the facular area, due to their lower contrast compared to sunspots, and the greater uncertainty in their contrast variation with viewing angle on the solar disk. Recent results from two separate photometric telescopes will be compared with bolometric observations from the active cavity radiometer irradiance monitor (ACRIM) that was on board the Solar Max satellite. Author

N91-12460*# Yale Univ., New Haven, CT. Center for Solar and Space Research.
BASIC MECHANISMS OF SOLAR VARIABILITY
Sabatino Sofia *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 23-26 (For primary document see N91-12456 03-92)
(Grant NAG5-736)
Avail: NTIS HC/MF A16 CSCL 03B

In order to simulate the behavior of a changing Sun in a realistic way, researchers have used a perturbation analysis (the results are summarized in Endal et al. 1985). In this approach, they use a standard solar model and then vary several of the model parameters to mimic the sudden or gradual change of some physical property within the Sun. The evolution following the perturbation is followed in a physically self-consistent way, that is, hydrostatic and thermal processes occur in their normal timescales. This treatment has allowed us to determine the sensitivity of the various global parameters to physical processes affecting the solar interior, and it has guided us in defining the least complex global solar model which can address the question of climatically significant variability. Not surprisingly, magnetic fields play the crucial role. The current status of the model, what researchers have already learned from it, and the future prospects are discussed. Author

N91-12461*# Yale Univ., New Haven, CT. Center for Solar and Space Research.
GLOBAL MODELS OF INTERMEDIATE TIMESCALE VARIABILITY ON THE SUN
Peter A. Fox *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 27-34 (For primary document see N91-12456 03-92)
(Grants NAGw-777; NAGw-778)
Avail: NTIS HC/MF A16 CSCL 03B

In recent years a number of advances in both observation and theory have increased our understanding of the solar interior and how to model it. For climate studies, the timescale of interest for changes in the Sun ranges from decades to centuries. Some of the theoretical advances that will contribute to the building of global models of the Sun's variability on intermediate timescales are described. The current constraints on the important components are discussed. Finally a short discussion presenting some implications for input to climate modeling is presented. Author

N91-12462*# Naval Research Lab., Washington, DC. Center for Space Research.
AN ESTIMATE OF CHANGES IN THE SUN'S TOTAL IRRADIANCE CAUSED BY UV IRRADIANCE VARIATIONS FROM 1874 TO 1988
J. Lean *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 35-41 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

Enhanced emission from bright solar faculae is a source of significant variation in the sun's total irradiance. Relative to the emission from the quiet sun, facular emission is known to be considerably greater at UV wavelengths than at visible wavelengths. Determining the spectral dependence of facular emission is of interest for the physical insight this may provide to the origin of the sun's irradiance variations. It is also of interest because solar radiation at lambda less than 300 nm is almost totally absorbed in the Earth's atmosphere. Depending on the magnitude of the UV irradiance variations, changes in the sun's irradiance that penetrates to the Earth's surface may not be equivalent to total irradiance variations measured above the Earth's atmosphere. Using an empirical model of total irradiance variations which accounts separately for changes caused by bright faculae from those associated with dark sunspots, the contribution of UV irradiance variations to changes in the sun's total irradiance is estimated during solar cycles 12 to 21. Author

N91-12463*# Research and Data Systems, Inc., Greenbelt, MD.
USING THE BOUNDARY CONDITIONS OF SUNSPOTS AS A TECHNIQUE FOR MONITORING SOLAR LUMINOSITY VARIATIONS
Douglas V. Hoyt *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 42-49 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

Recent satellite observations of the solar total irradiance confirm that it is varying at least on the 11 year time scale. Both blocking by sunspots and re-emission by faculae are components in this variation, but changes in the temperature of the solar photosphere may also be a contributing component. The satellite observations are as yet of insufficient length to answer the question of whether the sun is varying in luminosity on time scales longer than the 11 year sunspot cycle. Examined here are proxy methods of re-constructing these longer term luminosity variations, with an examination of secular changes in sunspot structure as one tool. Solar rotation changes and solar diameter changes are other parameters which may reveal information about solar luminosity variations. All three variables give remarkably similar conclusions. Over the last century the Earth's surface temperatures and the structure of sunspots have varied in a parallel manner. It is

hypothesized that sunspots have varied in a convective medium which itself is varying over long time periods. These variations in convective strength alter the boundary conditions on sunspots and hence cause their structure to vary. Simultaneous with the variations in convective strength, the solar luminosity will vary as well. This, in turn, leads to changes in the climate of the Earth. Variations in solar diameter and solar rotation support the hypothesis that solar luminosity has varied over the last century and reached a peak around 1925 to 1935. This evidence is reviewed along with a possible model of why sunspot structure may provide a good proxy measure of solar luminosity changes. Author

N91-12464*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ENERGY TRANSPORT BELOW SUNSPOTS AND FACULAE
Kenneth H. Schatten and Hans G. Mayr *In its* Climate Impact of Solar Variability Aug. 1990 p 50-5 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

Sunspots and faculae were modeled using a modified stellar envelope code. Downflow velocities of 50 m/sec can achieve a 1,000 K drop in the surface temperature of the photosphere and reduce the surface irradiance to half its value. Concurrently, a 600 km Wilson depression forms that is associated with the enhanced density of the cooler gases. Similar upflow velocities provide for slightly enhanced temperatures and 150 km uplifted surfaces for faculae. The calculations show that, to first approximation, sunspot and facular structures (in density, temperature and pressure) can be obtained by simply vertically shifting the undisturbed photospheric materials to form wells and hillock geometries, respectively. However, the chromospheric manifestations of these features can be quite different owing to the influence of the magnetic field and flow. Author

N91-12465*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SOLAR IRRADIANCE OBSERVED FROM PVO AND INFERRED SOLAR ROTATION
Charles L. Wolff and Walter R. Hoegy *In its* Climate Impact of Solar Variability Aug. 1990 p 57-6 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

Solar irradiance in the extreme ultraviolet flux (EUV) has been monitored for 11 years by the Pioneer Venus Orbiter (PVO). Since the experiment moves around the Sun with the orbital rate of Venus rather than that of Earth, the measurement gives us a second viewing location from which to begin unravelling which irradiance variations are intrinsic to the Sun, and which are merely rotational modulations whose periods depend on the motion of the observer. Researchers confirm an earlier detection, made with only 8.6 years of data, that the EUV irradiance is modulated by rotation rates of two families of global oscillation modes. One family is assumed to be r-modes occupying the convective envelope and sharing its rotation, while the other family (g-modes) lies in the radiative interior which as a slower rotation. Measured power in r-modes of low angular harmonic number indicates that the Sun's envelope rotated about 0.7 percent faster near the last solar maximum (1979 thru 1982) than it did during the next rise to maximum (1986 to 1989). No change was seen in the g-mode family of lines, as would be expected from the much greater rotational inertia of the radiative interior. Author

N91-12466*# Arizona Univ., Tucson. Dept. of Physics.
A CORRELATION BETWEEN CHANGES IN SOLAR LUMINOSITY AND DIFFERENTIAL RADIUS MEASUREMENTS
R. J. Kroll, H. A. Hill, and B. J. Beardsley (Photometrics, Inc., Tucson, AZ.) *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 65-72 Sponsored in part by DOE (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

Solar luminosity variations occurring during solar cycle 21 can be attributed in large part to the presence of sunspots and faculae. Nevertheless, there remains a residual portion of the luminosity variation distinctly unaccounted for by these phenomena of solar activity. At the Santa Catalina Laboratory for Experimental Relativity by Astrometry (SCLERA), observations of the solar limb are capable of detecting changes in the solar limb darkening function by monitoring a quantity known as the differential radius. These observations are utilized in such a way that the effects of solar activity are minimized in order to reveal the more fundamental structure of the photosphere. The results of observations made during solar cycle 21 at various solar latitudes indicate that a measurable change did occur in the global photospheric limb darkening function. It is proposed that the residual luminosity change is associated in part with this change in limb darkening. Author

N91-12467*# Chicago Univ., IL. Lab. for Astrophysics and Space Research.
SOLAR RESPONSE TO LUMINOSITY VARIATIONS
S. Arendt *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 73-77 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

The connection between solar luminosity and magnetic fields is now well-established. Magnetic fields under the guise of sunspots and faculae enhance or suppress heat transfer through the solar surface, leading to changes in the total solar luminosity. This raises the question of the effect that such surface heat transfer perturbations have on the internal structure of the sun. The problem has been considered previously by Foukal and Spruit. Here, researchers generalize the calculation of Spruit, removing the assumption of a constant heat diffusivity coefficient by treating the full mixing length heat transfer expression. Further, they treat the surface conditions in a simpler manner, and show that the previous conclusions of Foukal and Spruit are unaffected by these modifications. The model shows that following the application of a step function emissivity change: a fraction 1 - D(sub 0) of the luminosity change relaxes away after approx. 50 days. This corresponds to the thermal diffusion time across the convection zone, adjusting to a value in correspondence with the surface change. In other words, the whole convection zone feels the perturbation on this timescale. The remaining fraction relaxes away on a timescale of 10 to the 5th power years, corresponding to the convective layer radiating away enough energy so that it can adjust to its new adiabat. These are the same results arrived at by Spruit and Foukal. For variations of sigma on timescales of 10 to 200 years, then, the only important relaxation is the 50 day one. If the amplitude of this relaxation is small, the luminosity follows the sigma variation. Author

N91-12468*# Applied Research Corp., College Station, TX.
TESTING THE SUN-CLIMATE CONNECTION WITH PALEOCLIMATE DATA
Thomas J. Crowley and Matthew K. Howard *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 81-89 Sponsored in part by DOE (For primary document see N91-12456 03-92)
(Grant NSF ATM-87-22145)
Avail: NTIS HC/MF A16 CSCL 03B

If there is a significant sun-climate connection, it should be detectable in high-resolution paleoclimate records. Of particular interest is the last few thousand years, where we have both indices of solar variability (C-14 and Be-10) and climate variations (alpine glaciers, tree rings, ice cores, corals, etc.). Although there are a few exceptions, statistical analyses of solar and climate records generally indicates a flickering relationship between the two -- sometimes it seems to be present, sometimes not. The most repeatable solar climate periods occur at approx. 120 and approx. 56 yrs, although there is also evidence for approx. 420 and approx. 200 yrs. power in some records. However, coherence between solar and climate spectra is usually low, and occurrence of solar spectra in climate records is sometimes dependent on choice of analysis program. These results suggest in general a relatively weak sun-climate link on time scales of decades to centuries. This conclusion is consistent with previous studies and with the

observation that inferred climate fluctuations of 1.0 to 1.5 C on this time scale would require solar constant variations of approximately 0.5 to 1.0 percent. This change in forcing is almost an order of magnitude greater than observed changes over the last solar cycle and appears to be on the far-outer limit of acceptable changes for a Maunder Minimum-type event. Author

N91-12469*# Lamont-Doherty Geological Observatory, Palisades, NY.
SENSITIVITY OF THE OCEANIC TURBULENT BOUNDARY LAYER TO CYCLIC INSOLATION CHANGE WITH RESPONSE PERIODS OF 23 TO 2.5 Ky: AN EQUATORIAL ATLANTIC RECORD FOR THE LAST 200 Ka
Andrew McIntyre *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 90-97 Prepared in cooperation with Queens Coll., Flushing, NY (For primary document see N91-12456 03-92)
(Grants NSF OCE-85-16133; NSF OCE-86-08328; NSF ATM-88-12637)
Avail: NTIS HC/MF A16 CSCL 03B

Time series of sea-surface temperature in cores sited beneath the region of maximum divergence centered on 10 degrees W are characterized by two sets of periodic signals. The dominant signal is centered on a period of 23 Ky and is coherent with and lags, approx. 2.5 Ky, the precessional component of orbitally controlled insolation. The subdominant periods occur between 4.0 and 2.5 Ky. Both sets of signals record variation in the seasonal intensity of oceanic divergence modulated by variation in tropical easterly intensity. The longer periods are a response to precessional forcing. The forcing responsible for the shorter periods is unknown. Author

N91-12470*# Arizona Univ., Tucson. Lunar and Planetary Lab.
A PROBABLE APPROX. 2400 YEAR SOLAR QUASI-CYCLE IN ATMOSPHERIC DELTA C-14
L. L. Hood and J. L. Jirikowic *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 98-105 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

A 2200 to 2600 year quasi-periodicity is present in atmospheric delta C-14 records after removal of long-term trends due to the geomagnetic dipole amplitude variation. This periodicity consists of both a long-term variation of the mean and a superposed, approximately recurring pattern of century-scale variations. The strongest of these latter variations occur near maxima of the approx. 2400 year delta C-14 cycles. The residual record can be modeled to first order as an amplitude modulation of a century-scale periodic forcing function by a approx. 2400 year periodic forcing function. During the last millennium, the largest century-scale variations (occurring near the most recent 2400 year delta C-14 maximum) are known to be mainly a consequence of the pronounced Maunder, Sporer, and Wolf solar activity minima, as verified by independent proxy solar activity records. Therefore, during this period, amplitude modulation has been occurring primarily in the sun and not in the terrestrial radiocarbon system. It is therefore inferred that the approx. 2400 year forcing function is mainly solar although some secondary terrestrial feedback into the delta C-14 record is likely. This conclusion has implications for the predictability of future pronounced solar activity minima and for the interpretation of certain minor Holocene climatic variations. Author

N91-12471*# Arizona Univ., Tucson. Dept. of Planetary Sciences.
IS THE SUN A LONG PERIOD VARIABLE
Charles P. Sonett *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 106-114 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

The inventory of atmospheric radiocarbon exhibits quasi-periodic variations of mean period of bar-lambda=269 years over the entire 9000 year record. But the period is inconstant and subject to random variability (sigma m exp. 1/2 = 119 years). The radiocarbon maxima correspond to the quasiperiodic extension of the Maunder minimum throughout the Holocene and resolve the long-standing issue of Maunder cyclicity. The radiocarbon maxima are amplitude modulated by the approx. 2300 year period and thus vary significantly in peak value. The approx. 2300 year period in turn appears to not be modulated by the secular geomagnetic variation. Detection of a Maunder-like sequence of minima in tree ring growth of Bristlecone pine and its correlation with the Maunder (1890, 1922) cyclicity in the radiocarbon record supports the inference that solar forcing of the radiocarbon record is accompanied by a corresponding forcing of growth of timberline Bristlecone pine. Because of the random component of the Maunder period, prediction of climate, if tied to the Maunder cycle other than probabilistically, is significantly hindered. For the mean Maunder period of 269 years, the probability is 67 percent that a given climatic maximum lies anywhere between 150 and 388 years. Author

N91-12472*# Dartmouth Coll., Hanover, NH.
TRENDS IN SOLAR VARIABILITY Abstract Only
Robert Jastrow and Sallie Baliunas (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.) *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 115 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

Radiocarbon (delta C-14) records suggest a 200-year periodicity in solar activity in the last millennium. Researchers examined the Carbon-14 record going back 8 millennia for this and other periodicities. The computation differs from that in most previous work in its use of techniques developed for unevenly spaced sampling without rebinning the data to equally spaced intervals. A variation with a 200-year period is a strong feature of the Carbon-14 record going back several millennia. Periodicities that appear to be significant are listed and their physical interpretation discussed. Author

N91-12473*# Cambridge Research and Instrumentation, Inc., MA.
THE PROGRAM ON RADIATIVE INPUTS OF THE SUN TO THE EARTH (RISE) Abstract Only
Peter V. Foukal *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 116 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

General concerns about changes in the Earth's climate and in the ozone layer have increased the importance of measuring and understanding variations in the sun's radiative outputs. These outputs appear, for instance, at the top of the list of global change forcing agents in the recent FY-90 document on the U.S. Global Change Program. Significant advances have been made over the past decade in radiometry of the total solar irradiance. Photometry of light variations in stars similar to the sun, but much younger, is providing new insights into the sun's variations in luminosity and UV radiation at previous epochs of interest to paleoclimate studies. Measurement of the sun's 11-year output variability in the ultraviolet and extreme ultraviolet still possess a challenge of great importance. All of these topics are addressed by the program on Radiative Inputs of the Sun to Earth (RISE). RISE is a 5-year program of observations, data analysis, and theory, that has been defined at two workshops held in Boulder, Colorado in November 1987, and in Tucson, Arizona in October 1989. These meetings involved about 60 solar and atmospheric physicists, and stellar astronomers. A proceedings of the 1987 workshop was issued in early 1988. A substantial component of the program, consisting of ground-based observations, data analysis, and theory, is directed at the National Science Foundation (NSF) and the program is seeking a FY-92 funding start at the NSF. RISE also makes recommendations on measurements required from NASA and NOAA satellites. Author

N91-12474*# National Geophysical Data Center, Boulder, CO.
SOLAR ASTRONOMY DATA BASE: PACKAGED INFORMATION ON DISKETTE
John A. McKinnon *In* NASA, Goddard Space Flight Center,

Climate Impact of Solar Variability Aug. 1990 p 117 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

In its role as a library, the National Geophysical Data Center has transferred to diskette a collection of small, digital files of routinely measured solar indices for use on an IBM-compatible desktop computer. Recording these observations on diskette allows the distribution of specialized information to researchers with a wide range of expertise in computer science and solar astronomy. Every data set was made self-contained by including formats, extraction utilities, and plain-language descriptive text. Moreover, for several archives, two versions of the observations are provided - one suitable for display, the other for analysis with popular software packages. Since the files contain no control characters, each one can be modified with any text editor. Author

N91-12475*# National Oceanic and Atmospheric Administration, Boulder, CO. Space Environment Lab.
NOAA/TIROS AND GOES OBSERVATIONS OF GALACTIC AND SOLAR COSMIC RAYS OVER A SOLAR CYCLE
Herbert H. Sauer *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 118-124 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

Correlations between solar activity and atmospheric processes have been investigated for more than 30 years, and the reality of the strong correlations found has been well accepted. However, it remains problematic to establish mechanisms capable of coupling the physical manifestations of solar variability to the lower atmosphere. There has been to date a lack of long-term satellite measurements of particles of sufficient energy to penetrate the Earth's atmosphere. The NOAA Space Environment Laboratory has maintained energetic particle detectors on board the NOAA/TIROS and GOES series of satellites. These instruments monitor the flux of energetic protons to energies greater than about 800 MeV. Measurements of particles above 350 MeV began October 1978, and continue to date. The instruments are briefly described, along with the current program to reduce the data. The goal is to provide a data base that will help to assess the significance of variations of atmospheric and ionospheric properties due to energetic particle precipitation. Author

N91-12476*# Colorado Univ., Boulder.
DYNAMIC POWER SPECTRAL ANALYSIS OF SOLAR MEASUREMENTS FROM PHOTOSPHERIC, CHROMOSPHERIC, AND CORONAL SOURCES
S. D. Bouwer, J. Pap, and R. F. Donnelly *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 125-132 Prepared in cooperation with National Oceanic and Atmospheric Administration, Boulder, CO Sponsored in part by NOAA/Sun-Climate Staff (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

An important aspect in the power spectral analysis of solar variability is the quasistationary and quasiperiodic nature of solar periodicities. In other words, the frequency, phase, and amplitude of solar periodicities vary on time scales ranging from active region lifetimes to solar cycle time scales. Here, researchers employ a dynamic, or running, power spectral density analysis to determine many periodicities and their time-varying nature in the projected area of active sunspot groups (S sub act). The Solar Maximum Mission/Active Cavity Radiometer Irradiance Monitor (SMM/ACRIM) total solar irradiance (S), the Nimbus-7 MgII center-to-wing ratio (R (MgII sub c/w)), the Ottawa 10.7 cm flux (F sub 10.7), and the GOES background x ray flux (X sub b) for the maximum, descending, and minimum portions of solar cycle 21 (i.e., 1980 to 1986) are used. The technique dramatically illustrates several previously unrecognized periodicities. For example, a relatively stable period at about 51 days has been found in those indices which are related to emerging magnetic fields. The majority of solar periodicities, particularly around 27, 150 and 300 days, are quasiperiodic because they vary in amplitude and frequency throughout the solar cycle. Finally, it is shown that there are clear differences between the power spectral densities of solar measurements from photospheric, chromospheric, and coronal sources. Author

N91-12477*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, NY.
COMPARISON OF SOLAR AND OTHER INFLUENCES ON LONG-TERM CLIMATE **c45**
James E. Hansen, Andrew A. Lacis, and Reto A. Ruedy *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 135-145 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 13B

Examples are shown of climate variability, and unforced climate fluctuations are discussed, as evidenced in both model simulations and observations. Then the author compares different global climate forcings, a comparison which by itself has significant implications. Finally, the author discusses a new climate simulation for the 1980s and 1990s which incorporates the principal known global climate forcings. The results indicate a likelihood of rapid global warming in the early 1990s. Author

N91-12478*# National Oceanic and Atmospheric Administration, Boulder, CO. Aeronomy Lab.
SOLAR ACTIVITY AND THE SEA-SURFACE TEMPERATURE RECORD-EVIDENCE OF A LONG-PERIOD VARIATION IN SOLAR TOTAL IRRADIANCE **c45**
George C. Reid *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 146-148 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 13B

There have been many suggestions over the years of a connection between solar activity and the Earth's climate on time scales long compared to the 11-year sunspot cycle. They have remained little more than suggestions largely because of the major uncertainties in the climate record itself, and the difficulty in trying to compile a global average from an assembly of measurements that are uneven in both quality and distribution. Different climate time response to solar activity, some suggesting a positive correlation, some a negative correlation, and some no correlation at all. The only excuse for making yet another such suggestion is that much effort has been devoted in recent years to compiling climate records for the past century or more that are internally consistent and believable, and that a decadal-scale record of solar total irradiance is emerging from spacecraft measurements, and can be used to set limits on the variation that is likely to have occurred on these time scales. The work described here was originally inspired by the observation that the time series of globally averaged sea-surface temperatures over the past 120 years or so, as compiled by the British Meteorological Office group (Folland and Kates, 1984), bore a resonable similarity to the long-term average sunspot number, which is an indicator of the secular variability of solar activity. The two time series are shown where the sunspot number is shown as the 135-month running mean, and the SST variation is shown as the departure from an arbitrary average value. The simplest explanation of the similarity, if one accepts it as other than coincidental, is that the sun's luminosity may have been varying more or less in step with the level of solar activity, or in other words that there is a close coupling between the sun's magnetic condition and its radiative output on time scales longer than the 11-year cycle. Such an idea is not new, and in fact the time series shown can be regarded as a modern extension of the proposal put forward by Eddy (1977) to explain the covariance between various global climate indicators and solar activity as revealed by the C-14 record over the past millenium. Author

N91-12479*# Climate Analysis Center, Washington, DC.
JANUARY-FEBRUARY TROPOSPHERIC CLIMATE FOR THE NORTHERN HEMISPHERE AND THE 11-YEAR SOLAR CYCLE, THE QBO AND THE SOUTHERN OSCILLATION **c45**
Anthony G. Barnston and Robert E. Livezey *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug.

1990 p 149-163 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 13B

Examined here is a recently discovered association between the 11-year solar cycle and the atmosphere that is most easily detectable when the two phases of the Quasi-biennial Oscillation (QBO) are considered individually rather than pooled. The influence of the Southern Oscillation (SO) for either of the two QBO phases is then combined with that of the solar cycle in the form of two-predictor multiple regression. The strong and well-defined relationship between the 11-year 10.7 cm solar flux cycle and the lower troposphere Northern Hemisphere January-February climate for QBO phase-stratified samples (van Loon and Labitzke 1988, Barnston and Livezey 1989) failed for the west QBO phase in 1989. Here, the opposing 1989 event is explained, at least in part, on the basis of the phase of the SO (the cold tropical Pacific SST event of 1988 to 1989). It is demonstrated that both the SO and the solar flux have moderate and quasi-independent correlations with the climate over certain regions, and where there is strong overlap they can work either in harmony or in opposition. In 1989 in North America the influences of the SO and the flux conflicted to an unprecedented extent, and the SO was the controlling influence in most regions of the continent (western Canada being one exception). The 1989 event draws attention to the smallness of the QBO phase-stratified samples and the still more serious holes in the two-dimensional sample space of flux and SO when both factors are viewed as predictors within one QBO phase. Author

N91-12480*# Arizona Univ., Tucson. Lunar and Planetary Lab.
A MECHANISM INVOLVING SOLAR ULTRAVIOLET VARIATIONS FOR MODULATING THE INTERANNUAL CLIMATOLOGY OF THE MIDDLE ATMOSPHERE **c45**
L. L. Hood and J. L. Jirikowic *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 164-172 (For primary document see N91-12456 03-92)
(Grant NAGw-909)
Avail: NTIS HC/MF A16 CSCL 13B

In years of low solar activity, free traveling wave modes in the upper stratosphere are dominated by atmospheric normal modes such as the 16-day wave. However, within a 4-year interval centered on the 1980 to 1981 solar maximum, cross-spectral analyses of zonal mean satellite temperature data versus the solar UV flux demonstrate significant power near 27 and 13 days, providing indirect evidence that short-term UV variations were capable of exciting traveling planetary-scale waves in the upper stratosphere. Previous theoretical and observational work has indicated that interference between traveling waves and stationary waves forced from below (and the resulting oscillating latitudinal heat transports) plays a likely role in the initiation of stratospheric warmings. Researchers therefore hypothesize that the initiation of a major stratospheric warming in the upper stratosphere and lower mesosphere may depend to some extent on the amplitude of longer-period 27-day traveling waves in the upper stratosphere. This would represent a new mechanism for solar UV effects on stratospheric climatology that may be relevant to the interpretation of some recent long-term correlative results. Author

N91-12481*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
A SOLAR CONSTANT MODEL FOR SUN-CLIMATE STUDIES: 1600-2000AD
Kenneth H. Schatten and Jerome A. Orosz (Ohio Univ., Athens.) *In its* Climate Impact of Solar Variability Aug. 1990 p 175-180 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

Discussed here is the solar constant model published recently (Schatten, 1988), but with a modified phasing and amplitude. This model enables the known solar constant variations to be calculated from known active region and quiet region solar parameters. The features which can be modelled are sunspots and faculae, the only two features which mark the photospheric continuum with their unusual contrast behavior. They include both the active region features (sunspots and faculae) and the quiet region features (global faculae). Although the direct influences of sunspots upon the solar constant leads to short term decreases, an opposite, nearly in phase, 11 year variation in the solar constant is modelled, thereby agreeing with the Active Cavity Radiometer Irradiance Monitor (ACRIM) and Earth Radiation Budget (ERB) secular trends observed. This opposite behavior results primarily from global faculae (polar, network, and active region). The main contributors to the global behavior are the network faculae. The model attributes the observed variations in the solar constant entirely to magnetic features in the solar atmosphere. The present model serves purely to model the secular (long term) trend in the solar constant. The model suggests a change of approx. 0.5 W/sq m for the differences between the late twentieth century solar constant and the 17th century solar constant. This supports Eddy's view that this difference could give rise to the glacial increase during the little ice age of the 17th century. Important for present day climate studies, is that it shows the recent peak activity (peaking in 1958) is associated with an atypically high value of the solar constant, with respect to the past few hundred years. Author

N91-12482*# Geological Survey, Lawrence, KS.
A SOLAR-LUMINOSITY MODEL AND CLIMATE **c47**
Charles A. Perry *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 181-188 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 04B

Although the mechanisms of climatic change are not completely understood, the potential causes include changes in the Sun's luminosity. Solar activity in the form of sunspots, flares, proton events, and radiation fluctuations has displayed periodic tendencies. Two types of proxy climatic data that can be related to periodic solar activity are varved geologic formations and freshwater diatom deposits. A model for solar luminosity was developed by using the geometric progression of harmonic cycles that is evident in solar and geophysical data. The model assumes that variation in global energy input is a result of many periods of individual solar-luminosity variations. The 0.1-percent variation of the solar constant measured during the last sunspot cycle provided the basis for determining the amplitude of each luminosity cycle. Model output is a summation of the amplitudes of each cycle of a geometric progression of harmonic sine waves that are referenced to the 11-year average solar cycle. When the last eight cycles in Emiliani's oxygen-18 variations from deep-sea cores were standardized to the average length of glaciations during the Pleistocene (88,000 years), correlation coefficients with the model output ranged from 0.48 to 0.76. In order to calibrate the model to real time, model output was graphically compared to indirect records of glacial advances and retreats during the last 24,000 years and with sea-level rises during the Holocene. Carbon-14 production during the last millenium and elevations of the Great Salt Lake for the last 140 years demonstrate significant correlations with modeled luminosity. Major solar flares during the last 90 years match well with the time-calibrated model. Author

N91-12483*# Colorado Univ., Boulder.
MODELING SOLAR LYMAN ALPHA IRRADIANCE
J. Pap, H. S. Hudson, G. J. Rottman, R. C. Willson, R. F. Donnelly (National Oceanic and Atmospheric Administration, Boulder, CO.), and J. London *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 189-196 Sponsored in part by NOAA-Sun Climate Staff (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

Solar Lyman alpha irradiance is estimated from various solar indices using linear regression analyses. Models developed with multiple linear regression analysis, including daily values and 81-day running means of solar indices, predict reasonably well both the short- and long-term variations observed in Lyman alpha. It is shown that the full disk equivalent width of the He line at 1083 nm offers the best proxy for Lyman alpha, and that the total irradiance corrected for sunspot effect also has a high correlation with Lyman alpha. Author

N91-12484*# Naval Research Lab., Washington, DC. Center for Space Research.

SOLAR CYCLE MODULATION OF TOTAL IRRADIANCE: AN EMPIRICAL MODEL FROM 1874 TO 1988

J. Lean and P. Foukal (Cambridge Research and Instrumentation, Inc., MA.) *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 197-204 (For primary document see N91-12456 03-92)

Avail: NTIS HC/MF A16 CSCL 03B

Evidence acquired during the past decade indicates that over time scales of the solar cycle, enhanced emission from bright solar faculae cause significant variations in the sun's total irradiance even though, on shorter time scales, the most pronounced variations are those resulting from the passage of dark sunspots across the solar disc. An empirical model which accounts for the competing effects of dark sunspots and bright faculae has been developed from the available radiometry in cycle 21, and extended back to the beginning of solar cycle 12. According to this model, the largest 11-year modulation of total irradiance during the C20th occurred in the most recent cycle 21. Author

N91-12485*# Texas A&M Univ., College Station. Climate System Research Program.

CLIMATE FLUCTUATIONS AND CLIMATE SENSITIVITY c47

Gerald R. North and Kuor-Jier Joseph Yip *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 207-218 (For primary document see N91-12456 03-92)

Avail: NTIS HC/MF A16 CSCL 04B

Some evidence is presented that the main part of the atmospheric climate system is such that small forcings in the heat balance lead to linear responses in the surface temperature field. By examining first a noise forced energy-balance climate model and then comparing it with a long run of a highly symmetrical general circulation model, one finds a remarkable connection between spatial autocorrelation statistics and the thermal influence function for a point heat source. These findings are brought together to indicate that this particular climatological field may be largely governed by linear processes. Author

N91-12486*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

FEEDBACK PROCESSES AND CLIMATE RESPONSE c47

Albert Arking *In its* Climate Impact of Solar Variability Aug. 1990 p 219-226 (For primary document see N91-12456 03-92)

Avail: NTIS HC/MF A16 CSCL 04B

The response of the climate system to an external perturbation--e.g., a change in solar irradiance or a change in atmospheric opacity due to an increase in CO2--depends rather strongly on feedback processes in the system, which either amplify or dampen the effects of the initial perturbation. A simple representation of the climate system is used to compare several important feedbacks, based upon general circulation model (GCM) simulations by various investigators. The models are in general agreement with respect to water vapor feedback, but in wide disagreement with respect to cloud feedback. Because of the arguments raised by Lindzen (1990)--that the processes which determine water vapor mixing ratio in the upper atmosphere are quite different from those which operate in the planetary boundary layer, and that upper tropospheric water vapor might actually decrease even when the boundary layer is getting warmer and more moist--researchers undertook a study to determine the sensitivity of climate to changes in water vapor at various levels in the troposphere. The result is that climate is just as sensitive to percentage changes in upper tropospheric water vapor, where the mixing ratio is very small, as it is to percentage changes in the boundary layer, which contains the bulk of total column water vapor. Author

N91-12487*# Florida State Univ., Tallahassee. Dept. of Meteorology.

ON THE DECADAL MODES OF OSCILLATION OF AN IDEALIZED OCEAN-ATMOSPHERE SYSTEM c48

Vikram M. Mehta *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 227-234 (For primary document see N91-12456 03-92)

(Contract DE-FC05-85ER-25000; NSF ATM-87-14674)

Avail: NTIS HC/MF A16 CSCL 08C

Axially-symmetric, linear, free modes of global, primitive equation, ocean-atmosphere models are examined to see if they contain decadal (10 to 30 years) oscillation time scale modes. A two-layer ocean model and a two-level atmospheric model are linearized around axially-symmetric basic states containing mean meridional circulations in the ocean and the atmosphere. Uncoupled and coupled, axially-symmetric modes of oscillation of the ocean-atmosphere system are calculated. The main conclusion is that linearized, uncoupled and coupled, ocean-atmosphere systems can contain axially-symmetric, free modes of variability on decadal time scales. These results have important implications for externally-forced decadal climate variability. Author

N91-12488*# Virginia Univ., Charlottesville. Dept. of Environmental Sciences.

WHAT COULD BE CAUSING GLOBAL OZONE DEPLETION c45

S. Fred Singer *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 235-240 (For primary document see N91-12456 03-92)

Avail: NTIS HC/MF A16 CSCL 13B

The reported decline trend in global ozone between 1970 and 1986 may be in part an artifact of the analysis; the trend value appears to depend on the time interval selected for analysis--in relation to the 11-year solar cycle. If so, then the decline should diminish as one approaches solar maximum and includes data from 1987 to 1990. If the decline is real, its cause could be the result of natural and human factors other than just chlorofluorocarbons. Author

N91-12489*# Leningrad Univ. Observatory (USSR). Dept. of Atmospheric Physics.

ON THE VARIABILITY OF THE SOLAR INTEGRAL RADIATION CONSTITUENTS

G. A. Nikolsky *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 241-248 (For primary document see N91-12456 03-92)

Avail: NTIS HC/MF A16 CSCL 03B

The results of spectral analysis of series of observations of the equatorial and polar diameters, as well as of series of satellite observations of the S sub O variations during 1975 to 1987 presented in papers by Laclare (1987), Delache (1988) and Delache et al. (1988) confirm with confidence the presence of an 11-year modulation in the Sun's radiation and diameter, and consequently, in the effective temperature of the photosphere. The same conclusion has been drawn with regard to the 1000th and 320th daily periodicities. In combination with the results of other research, several obvious conclusions can be drawn from the data presented. The 76-year variation in the period from 1967 to 1987 is not revealed in the data of observations; the data of the middle series will doubtless be made more precise after the facsimile from the initial information is obtained. The basic and comparable contributions to the radius variability yield the 11- and 22-year variations. The presence can easily be seen of harmonics with periods of 2 and 4 years; the 4-year period is revealed up to 1979 only, and the 2-year one, after 1980 only. This is possibly due to the combined contribution of the 11- and 22-year variations (to be more precise, 10.8 and 21.2 years) forming a certain mean 16-year periodicity. In this case, the 4- and 2-year variations can be regarded as the 4th and 8th harmonics of such a mean variation. Measurements of the horizontal diameter made at Greenwich Observatory have not lost their significance for the analysis of phenomena on the Sun, since they contain data having precision

characteristics conforming to the level of the latest ground-based diameter measurements. Author

N91-12490*# Texas Univ. at Dallas, Richardson. Center for Space Science.
FORCING OF CLIMATE VARIATIONS BY MeV-GeV PARTICLES **c47**
Brian A. Tinsley *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 249-258 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 04B

Changes in ionization production in the lower stratosphere by a few percent during Forbush decreases have been shown to correlate well with changes in winter tropospheric dynamics by a similar relatively small amount. Changes in ionization production by tens of percent on the decadal time scale have been shown to be correlated with changes in winter storm frequencies by tens of percent in the western North Atlantic. Changes in total solar irradiance or solar UV do not have time variations to match the tropospheric variations on the day to day time scales discussed here. Forcing related to magnetic activity is not supported. Thus solar wind/MeV-GeV particle changes appear to be the only viable forcing function for these day to day variations. If solar wind/particle forcing of a few percent amplitude can produce short term weather responses, then observed changes by tens of percent on the decadal and centennial time scale could produce climate changes on these longer time scales. The changes in circulation involved would produce regional climate changes, as observed. At present the relations between stratospheric ionization, electric fields and chemistry and aerosol and cloud microphysics are as poorly known as the relations between the latter and storm feedback processes. However, the capability for investigating these relationships now exists and has recently been most successfully used for elucidating the stratospheric chemistry and cloud microphysics associated with the Antarctic ozone hole. The economic benefits of being able to predict winter severity on an interannual basis, and the extent to which climate change related to solar variability will add to or substract from the greenhouse effect, should be more than adequate to justify support for research in this area. Author

N91-12491*# Schroeter Inst. for Research in Cycles of Solar Activity, Belle Cote (Nova Scotia).
RELATIONSHIP BETWEEN RAINFALL IN THE NORTHERN HEMISPHERE AND IMPULSES OF THE TORQUE IN THE SUN'S MOTION
T. Landscheidt *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 259-266 Sponsored in part by the Foundation for the Study of Cyles, Irvine, CA (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

The analysis of major change in the angular momentum of the sun's irregular motion about the barycenter of the solar system, represented by extrema in the running variance of impulses of the torque (IOT), discloses a connection with both extrema in the Gleissberg cycle of secular sunspot activity and maxima in the thickness of varves from Lake Saki, Crimea. This significant relationship can be traced back to the 7th century. Further inquiries link the running variance in IOT to rainfall over central Europe, England, Wales, eastern United States, and India, as well as to temperature in Europe. This significant correlation covers more than 130 years. Author

N91-12492*# World Radiation Center, Davos (Switzerland).
IRRADIANCE VARIABILITY OF THE SUN
Claus Froehlich *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 269-278 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

Direct measurements of the solar constant--the total irradiance at mean Sun-Earth distance--during the last ten years from satellites show variations over time scales from minutes to years and decades. At high frequencies the spectral power is determined by granulation, super- and mesogranulation. In the 5-minute range, moreover, it is dominated by power from the solar p-mode oscillations. Their power and frequencies change with time, yielding information about changes in the convection zone. During periods of several hours, the power is steadily increasing and may be partly due to solar gravity modes. The most important variance is in the range from days to several months and is related to the photospheric features of solar activity, decrease of the irradiance during the appearance of sunspots, and increasing by faculae and the magnetic network. Long-term modulation by the 11-year activity cycle are observed conclusively with the irradiance being higher during solar maximum. All these variations can be explained--at least qualitatively--by their manifestation on the photosphere. For the long-term changes, the simultaneous changes of the frequencies of solar p-mode oscillations suggest a more global origin of the variations. Indeed, it seems that the observed irradiance modulation is a true luminosity change with the magnetic cycle of the Sun. Author

N91-12493*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SOLAR IRRADIANCE VARIABILITY DURING SOLAR CYCLES 21 AND 22 Abstract Only
Richard C. Willson *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 279 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

Total solar irradiance observations by the Active Cavity Radiometer Irradiance Monitor (ACRIM) on the Solar Maximum Mission, the Nimbus 7/Earth Radiation Budget (ERB), the NASA/Earth Radiation Budget Satellite (ERBS), and NOAA 9/Earth Radiation Budget Experiment (ERBE) are combined to demonstrate the characteristics of the variation of solar luminosity over the solar cycles 21 and 22 between 1978 and 1990. Observations of solar Lyman Alpha and 10.7 MHz fluxes are used to demonstrate a total irradiance variability asymmetry relative to the maximum of solar activity. Author

N91-12494*# California Univ., San Diego. Center for Astrophysics and Space Sciences.
THE ACRIM DATA IN THE CONTEXT OF STELLAR VARIABILITY
Hugh S. Hudson *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 280-286 (For primary document see N91-12456 03-92)
(Grant NAG5-1321)
Avail: NTIS HC/MF A16 CSCL 03B

The Active Cavity Radiometer Irradiance Monitor (ACRIM) total-irradiance data from the Solar Maximum Mission have given a first comprehensive view of solar variability in the stellar sense. Five types of solar variability have been identified thus far. These have small amplitudes, less than a few tenths of one percent, and are at levels generally not yet detectable on other stars. The possible stellar analogs are interesting physically, and in particular may help us to understand solar behavior on longer time scales. The ACRIM data is described from the stellar point of view. The present state of stellar time-series photometry is discussed.
Author

N91-12495*# Air Force Geophysics Lab., Sunspot, NM.
THE VARIATION OF SOLAR Fe 14 AND Fe 10 FLUX OVER 1.5 SOLAR ACTIVITY CYCLES
Richard C. Altrock *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 287-292 Sponsored in part by NSF (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

A new source of data on the solar output, namely limb flux from the one- and two-million degree corona is presented. This parameter is derived from data obtained at the National Solar Observatory at Sacramento Peak with the 40 cm coronagraph of the John W. Evans Solar Facility and the Emission Line Coronal Photometer. The limb flux is defined to be the latitude-averaged intensity in millionths of the brightness of disk center from an

annulus of width 1.1 minutes centered at a height of 0.15 solar constant above the limb of emission from lines at 6374A (Fe X) or 5303A (Fe XIV). Fe XIV data have been obtained since 1973 and Fe X since 1984. Examination of the Fe XIV data shows that there is ambiguity in the definition of the last two solar activity minima, which can affect the determination of cycle rise times and lengths. There is an indication that a constant minimum or basal corona may exist at solar minimum. Cycle 22 has had a much faster onset than Cycle 21 and has now overtaken Cycle 21. The rise characteristics of the two cycles were very similar up until Jul. to Aug. 1989, at which time a long-term maximum occurred in Fe X and Fe XIV, which could possibly be the solar maximum. Another maximum is developing at the current time. Cycle 21 was characterized in Fe XIV by at least 4 major thrusts or bursts of activity, each lasting on the order of a year and all having similar maximum limb fluxes which indicates that coronal energy output is sustained over periods in which the sunspot number declines significantly. Dramatic increases in the limb fluxes occur from minimum to maximum, ranging from factors of 14 to 21 in the two lines. Two different techniques to predict the epoch of solar maximum have been applied to the Fe XIV data, resulting in estimates of April 1989 (plus or minus 1 mo) and May 1990 (plus or minus 2 mos). Author

N91-12496*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

AN ALTERNATIVE DERIVATION OF THE NIMBUS 7 TOTAL SOLAR IRRADIANCE VARIATIONS

Douglas V. Hoyt (Research and Data Systems, Inc., Greenbelt, MD.) and H. Lee Kyle *In its* Climate Impact of Solar Variability Aug. 1990 p 293-300 (For primary document see N91-12456 03-92)

Avail: NTIS HC/MF A16 CSCL 03B

Nimbus 7 solar irradiance values have been made available to the scientific community through the open literature (e.g., Hickey et al., 1988) and through NASA data centers. A comparison of these measurements to the Solar Maximum Mission/Active Cavity Radiometer Irradiance Monitor (SSM/ACRIM) time series indicated differences which might be caused in part by the method of converting the Nimbus 7 raw data counts to solar irradiance values. In an effort to see if the derivation of the solar irradiance could be improved, the raw counts were extracted from the tapes and analyzed to see how a new algorithm could be constructed. The basic form of the calibration remains the same as in the previous solar irradiance derivations. However, the input values to the equation differ from what was used before. In particular, improved values of the Earth-sun distance are incorporated and new temperature sensitivities were derived. Several problems with the instrument were uncovered which previously had not been noticed. The sun did not appear to cross the center of field of the radiometer but was systematically off by 1.5 to 2.5 degrees. The analog to digital convertor changed its properties in July 1980. The gain of the electronics apparently increased by 0.03 percent in September 1987. Applying these and other changes in the processing, the day to day variations appear much more like the SMM observations. In fact, the Nimbus 7 observations are sufficiently stable that a problem with the SSM observations in the spin mode period of 1981 to 1984 can be detected when the two time series are compared. Author

N91-12497*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

LONG-TERM SOLAR IRRADIANCE VARIABILITY: 1984-1989 OBSERVATIONS

Robert B. Lee, III *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 301-308 (For primary document see N91-12456 03-92)

Avail: NTIS HC/MF A16 CSCL 03B

Long-term variability in the total solar irradiance has been observed in the Earth Radiation Budget Experiment (ERBE) solar monitor measurements. The monitors have been used to measure the irradiance from the Earth Radiation Budget Satellite (ERBS) and the National Oceanic and Atmospheric Administration NOAA-9 and NOAA-10 spacecraft platforms since October 25, 1984, January 23, 1985, and October 22, 1986, respectively. Before September 1986, the ERBS irradiance values were found to be decreasing -0.03 percent per year. This period was marked by decreasing solar magnetic activity. Between September 1986 and mid-1989, the irradiance values increased approximately 0.1 percent. The latter period was marked by increasing solar activity which was associated with the initiations of the sunspot cycle number 22 and of a new 22-year Hale solar magnetic cycle. Therefore, long-term solar-irradiance variability appears to be correlated directly with solar activity. The maximum smoothed sunspot number occurred during September 1989, according to the Sunspot Index Data Center. Therefore, the recent irradiance increasing trend should disappear during early 1990 and change into a decreasing trend if the observed irradiance variability is correlated more so with the 11-year sunspot cycle than the 22-year Hale cycle. The ERBE irradiance values are presented and compared with sunspot activity for the 1984 to 1989 period. The ERBE values are compared with those available from the Nimbus-7 and Solar Maximum Mission spacecraft experiments. Author

N91-12498*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

SOLAR CONSTANT DATA FROM EARTH RADIATION BUDGET MEASUREMENTS

A. T. Mecherikunnel, H. L. Kyle, and Robert B. Lee, III (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.) *In its* Climate Impact of Solar Variability Aug. 1990 p 309-316 (For primary document see N91-12456 03-92)

Avail: NTIS HC/MF A16 CSCL 03B

At present, solar total irradiance measurements are made from four satellites using electrically self calibrating pyrheliometers, as a part of the earth radiation budget measurement programs. The Earth Radiation Budget (ERB) mission onboard Nimbus-7 spacecraft (Nimbus/ERB) started solar total irradiance measurements in November 1978, and is still obtaining irradiance data on every orbit, daily. The Earth Radiation Budget Experiment (ERBE) solar monitors onboard Earth Radiation Budget Satellite (ERBS), NOAA-9 and NOAA-10 started solar total irradiance measurements in October 1984, January 1985, and October 1986, respectively. Our knowledge of solar total irradiance and its variability has grown remarkably during the past few years, as a result of the above measurements, and the high precision data obtained from Solar Maximum Mission/Active Cavity Radiometer Irradiance Monitor-1 (SMM/ACRIM-1). The results from a comparative study of the solar constant data available from the above missions are presented. The solar constant value derived from the sensors agree within the uncertainty associated with absolute pyrheliometers available at present. An attempt will be made to correlate the solar irradiance variability with other solar parameters. The measurements from Nimbus-7/ERB started November 1978, as the solar cycle 21 was increasing in activity. The solar luminosity reached a maximum in the spring of 1979. The irradiance then decreased slowly to a minimum which lasted from 1984 through 1986. The irradiance is presently increasing towards a new maximum. It appears that the solar constant value follow an eleven year cycle. Author

N91-12499*# National Science Foundation, Washington, DC. Div. of Atmospheric Sciences.

A REVIEW AND REFLECTIONS ON THE SUN-CLIMATE CONNECTION Abstract Only **c47**

Richard A. Goldberg *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 319 (For primary document see N91-12456 03-92)

Avail: NTIS HC/MF A16 CSCL 04B

The field of sun-climate is beset with an extraordinary number of numerical correlations attempting to relate various periodicities of solar activity with changes in the Earth's weather and climate. Signatures representing climatological variabiity have been sought for cycles as short as the solar 28-day rotational period up to Milankovich periods of thousands of years, although a majority of

correlations have concentrated on the 11-year sunspot and 22-year Hale double sunspot cycles. For the shorter term, parameters including temperature, pressure, winds storm tracks, rainfall, and water levels in rivers and lakes, etc. have been correlated with solar variability. For longer periods, it has been necessary to seek more indirect evidence in ice cores, tree rings, and geologic deep sea cores. Other atmospheric parameters relating to atmospheric electricity and the global wide spectrum of numerical correlations have been associated with any viable physical explanation, making most studies in the field an exercise in numerical statistics. More recently, a few suggestions for plausible coupling processes have begun to appear. These, coupled with new and stronger correlations involving selective binning of climatological data sets have injected new life and hope to this field. An overview is given of the historical past and current perspectives, to evaluate possible avenues for defining physical linking processes in the future. Author

N91-12500*# Colorado Univ., Boulder. Astrophysical, Planetary and Atmospheric Sciences.
WAVELENGTH DEPENDENCE OF SOLAR ROTATION AND SOLAR CYCLE UV IRRADIANCE VARIATIONS
Julius London and Gary J. Rottman *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 323-327 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

It is shown that for the 5-year period 1982 to 1987 the solar irradiance decrease is estimated to be about 5 to 7 percent over the spectral interval 195 to 225 nm. This change becomes progressively smaller with increasing wavelength. For the 2-1/3 year period, January 1987 to April 1989, the irradiance increases about 6 percent at 195 to 205 nm and about 2 percent between 215 to 250 nm. Both 27-day and 13.5-day relative amplitudes peak at the time near solar maximum (1982) but remain comparatively small between 1983 and the onset of solar cycle 22. An average 280 day oscillation is noted for wavelengths up to 230 nm. No physical mechanism is offered for this variation. Author

N91-12501*# National Oceanic and Atmospheric Administration, Boulder, CO. Space Environment Lab.
SOLAR UV TEMPORAL VARIATIONS DURING SOLAR CYCLE 22 AND THE TWENTIETH CENTURY
Richard F. Donnelly *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 328-335 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

Solar ultraviolet measurements of the Mg II core-to-wing ratio from the NOAA9 satellite show a fast rise for solar cycle 22 from the minimum in September 1986. The high values in late 1989 are comparable to the maximum values for cycle 21. Estimates of earlier solar UV variations are made back to 1947 using a combination of the 10 cm solar radio flux (F10) and the sunspot blocking function. The latter is interpreted to partially remove the gyroresonance component from F10, which is not present in the UV flux. Author

N91-12502*# National Solar Observatory, Tucson, AZ.
SECULAR CHANGE IN EQUIVALENT WIDTH OF C 5380, 1978-1990
William C. Livingston *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 336-340 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 03B

The equivalent width of the high excitation photospheric line of C 5380A has been measured 3 to 4 times monthly in the solar irradiance spectrum since 1978. C 5380 behaves differently than other spectral lines in that it is unmodulated by the activity cycle, yet has increased in strength by 0.081 plus or minus .008 mA in 12 years. Nominal equivalent width is 22.25 mA. Implied is a temperature increase of 4.6 K which is an order of magnitude greater than constraints allowed by Active Cavity Radiometer Irradiance Monitor (ACRIM) results. Author

N91-12503*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
TEN YEARS OF SOLAR CHANGE AS MONITORED BY SBUV AND SBUV/2
B. M. Schlesinger, R. P. Cebula, D. F. Heath, M. T. DeLand (ST Systems Corp., Lanham, MD.), and R. D. Hudson *In its* Climate Impact of Solar Variability Aug. 1990 p 341-348 (For primary document see N91-12456 03-92)
(Contract NAS5-29386)
Avail: NTIS HC/MF A16 CSCL 03B

Observations of the Sun by the Solar Backscatter Ultraviolet (SBUV) instrument aboard Nimbus 7 and the SBUV/2 instrument aboard NOAA-9 reveal variations in the solar irradiance from 1978, to 1988. The maximum to minimum solar change estimated from the Heath and Schlesinger Mg index and wavelength scaling factors is about 4 percent from 210 to 260 nm and 8 percent for 180 to 210 nm; direct measurements of the solar change give values of 1 to 3 percent and 5 to 7 percent, respectively, for the same wavelength range. Solar irradiances were high from the start of observations, late in 1978, until 1983, declined until early 1985, remained approximately constant until mid-1987, and then began to rise. Peak-to-peak 27-day rotational modulation amplitudes were as large as 6 percent at solar maximum and 1 to 2 percent at solar minimum. During occasional intervals of the 1979 to 1983 maximum and again during 1988, the dominant rotational modulation period was 13.5 days. Measurements near 200 to 205 nm show the same rotational modulation behavior but cannot be used to track long-term changes in the Sun because of uncertainties in the characterization of long-term instrument sensitivity changes. Author

N91-12504*# Academy of Sciences (USSR), Leningrad.
SOME RESULTS FROM STUDIES ON RELATIONSHIPS BETWEEN THE OPTICAL-METEOROLOGICAL PARAMETERS AND SOLAR ACTIVITY. PART 2: DEVELOPMENT OF THE PROBLEM OF SOLAR FORCING **c47**
K. Y. Kondratyev and G. A. Nikolsky (Leningrad State Univ., USSR) *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 351-353 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 04B

A set of complex spectral, actinometric and meteorological data obtained in the periods of heightened solar activity (1981 and 1988) has been considered in order to reveal the atmospheric component affected by solar emissions in the troposphere and lower stratosphere. For the first time, it has been found out that water vapor molecules can be transformed, under the impact of corpuscular and microwave solar emissions, from the free state to the bound one (association into clusters), and vice versa. The transition of water vapor molecules into the bound state results in a decrease of spectral optical thickness in the visible, near IR and IR spectral regions, and an appearance and deepening of the cluster absorption bands at wavelengths 330 to 340, 365, 380 to 390, and 480 nm. Author

N91-12505*# Geological Survey, Lawrence, KS.
SPECULATION ON A SOLAR CHRONOMETER FOR CLIMATE **c47**
Charles A. Perry *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 357-364 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 04B

Solar activity has been correlated to climatic fluctuations and has been postulated as a major factor in quasi-periodic global climatic change. However, correlations are not explanations of physical mechanisms and do not couple cause with effect. A mechanism for a chronometer for solar output variability is proposed based on relations between properties of thermonuclear fusion, nuclear magnetic moment, and nuclear magnetic resonance. A fundamental oscillation of a nucleus with a net nuclear magnetic moment (NMM) is the precession of its axis of rotation when subjected to a magnetic field. Nuclear magnetic resonance (NMR) is the preferred frequency of precession for a nucleus of a particular

isotope when placed in a magnetic field of specific intensity. The NMM for those isotopes involved in the proton-proton (p-p) chain pathway for solar fusion varies from strong positive to strong negative. Individual fusion events, for hydrogen and helium isotopes which release varying amounts of energy, may be controlled by NMR frequencies. The pulses of energy from fusion events occurring at NMR frequencies in the solar interior may be transformed into pressure or gravity waves that emerge as gravity or acoustic waves at the surface. Dictated by spherical harmonics, certain wavelengths may be reinforced and reenter the solar interior to modulate the fusion process. Qualitative analysis of solar and climatic data support the interaction of the three basic components of the chronometer, magnetic activity, oscillation frequency, and solar energy output. Author

N91-12506*# Kitt Peak National Observatory, Tucson, AZ.
TRACKING ATMOSPHERIC TRACE GASES BY SPECTROSCOPY FROM KITT PEAK Abstract Only **c45**
Lloyd Wallace and William Livingston (National Solar Observatory, Tucson, AZ.) *In* NASA, Goddard Space Flight Center, Climate Impact of Solar Variability Aug. 1990 p 365 (For primary document see N91-12456 03-92)
Avail: NTIS HC/MF A16 CSCL 13B

Researchers analyzed solar spectra obtained with the 1-m Fourier Transfer Spectrometer (FTS) for absorption by CO2, CH4, N2, CO, HF, and HCl. During the period 1979 to 1985, they found that the CO2 total column amount was increasing 0.4 percent/year, CH4 was up 1.1 percent/year, while N2O shows no detectable trend. CO undergoes a large seasonal variation that masks any long-term trend within the observational time span. Stratospheric HF doubles in strength, displaying a conspicuous single-point increase that coincided with the mystery volcanic event of that era. Researchers are now attempting to resume the observations as resources permit. Author

N91-12507# Bern Univ. (Switzerland). Div. of Solar Observations.
BERNE SOLAR OBSERVATIONS: SOLAR DATA FOR JANUARY - JUNE 1990
A. Magun, M. Fuhrer, G. Bruggmann, M. Graeter, S. Eder, and R. Herrmann 1990 46 p
(Rept-57; ETN-90-98232) Avail: NTIS HC/MF A03

Specifications for solar radio observations and solar flare observations at H-alpha are given. During this period, no H-alpha observations were carried out. Outstanding events are listed. A series of graphics of the data is presented. ESA

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N91-12508 Illinois Univ., Urbana-Champaign.
A STUDY OF ELECTRON-POSITRON PAIR EQUILIBRIA IN MODELS OF COMPACT X- AND GAMMA-RAY SOURCES Ph.D. Thesis
Gunnlaugur Bjoernsson 1990 140 p
Avail: Univ. Microfilms Order No. DA9026142

Thermal electron-positron pair equilibria in two temperature models of compact x ray and gamma ray sources are studied. The pairs are assumed to be heated by Coulomb interaction with the much hotter protons and cooled by bremsstrahlung emission, Compton scattering, and annihilation. Two parameters, the proton optical depth and the compactness, characterize each equilibrium state. It is shown that a careful account of the energy balance is very important when the stability properties of the pair equilibria in a spherical plasma cloud are determined. The equilibria are found to be unstable in a very limited range of compactness and proton optical depth. This particular instability is unlikely to be the cause of the observed variability of the compact sources and implies that it is possible to build up high pair densities by a thermal mechanism in two temperature environments. The most important result considers the effects of pairs on the structure of geometrically and effectively optically thin accretion disks. A new approach for solving for the equilibrium structure of the disks is presented. In effect, the pair equilibrium states are projected into the space spanned by the disk structure parameters. This allows a direct visualization of all possible disk solutions at once. Each solution profile needs to be calculated only once and a complete disk solution is obtained by a simple radial coordinate transformation. The disk solutions are thus seen to be scale free in terms of the radial coordinate as well as in terms of the mass of the central object and the accretion rate. Two particular disk solutions are given. It is shown that including electron-positron pairs in the disk structure calculations leads to a breakdown of the thin disk assumptions and that more detailed disk modeling is required before electron-positron pairs can be self-consistently included. Dissert. Abstr.

N91-12509 Boston Univ., MA.
ANALYSIS OF DEEP UNDERGROUND MULTIPLE MUONS AND THE COSMIC RAY COMPOSITION ABOVE 10 TeV/NUCLEUS Ph.D. Thesis
Daniel S. Levin 1990 219 p
Avail: Univ. Microfilms Order No. DA9023987

The initial data run of the Monopole Astrophysics Cosmic Ray Observatory (MACRO) muon tracking detector occurred in the Spring of 1989. The first detector supermodule, geometrical acceptance approximately 8000 sq m, has yielded about 2.2 x 10(exp 5) single and 10(exp 4) multiple muon events representing interactions of energetic primary nuclei at the top of the atmosphere. This data set is analyzed in the context of semi-extrapolated accelerator physics charged meson production in which the elemental composition and energy dependence of the incident cosmic beam are regarded as unknown within specified constraints. The depth-intensity relation, sec(theta) enhancement and muon bundle lateral separation distributions are shown to be consistent with the fundamental assumptions of the hadronic interactions employed in muon yield parameterizations due to Gaisser and Stanev. Inferences of conceivable primary mass spectra that may be progenitors of the observed multiplicity distribution are made through Monte Carlo simulations incorporating these parameterizations. The data are compared with the simulations in which light and heavy mass composition models are input. The data for lower muon multiplicities are found to be consistent with a composition model derived from measurements of the CRN (Spacelab-2) and Japanese-American cooperative emulsion experiment (JACEE) balloon emulsion chamber experiments. Dissert. Abstr.

N91-12510 New Hampshire Univ., Durham.
OBSERVATIONS OF COSMIC GAMMA RAY SOURCES AND THEIR CONTRIBUTION TO THE DIFFUSE GAMMA RAY BACKGROUND Ph.D. Thesis
Debadarshi Bhattacharya 1990 180 p
Avail: Univ. Microfilms Order No. DA9027423

The objective is to study soft gamma ray emission in the 0.1 to 10 MeV energy band for selected active galactic nuclei and explore how much they contribute to the total diffuse gamma ray background. A series of imaging observations of extragalactic objects in the low energy gamma-ray region were carried out by the Coded Aperture Directional Gamma-ray Telescope (DGT). The DGT was successfully flown at stratospheric balloon altitudes, and observations were made of the Crab, NGC 1275, MKN 421, and NGC 4151. The measured Crab spectrum is consistent with a featureless power-law of the form. Significant emission was detected up to 500 keV from the Seyfert galaxy, NGC 4151. To increase the total sky exposure the extragalactic field images were analyzed, including the 3C 273 region, obtained by the DGT.
Dissert. Abstr.

N91-12511 Pennsylvania Univ., Philadelphia.
HEAO A-1 OBSERVATIONS OF X RAY EMITTING CLUSTERS OF GALAXIES Ph.D. Thesis
Michael William Johnson 1990 199 p
Avail: Univ. Microfilms Order No. DA9026585

Clusters of galaxies were known to be sources of x ray emission. Statistical analysis of how the x ray emission from clusters is related to other cluster properties was limited by the small number of clusters observed in the x ray region and the completeness of the x ray sample being considered. Both of these limitations are solved by producing a flux-limited catalog of x ray emitting Abell clusters of galaxies and using this catalog to investigate how the x ray emission correlates with other cluster properties. X ray data from the HEAO A-1 experiment were used to search for x ray emission from Abell clusters of galaxies. Selection criteria were chosen to ensure that the resulting catalog was complete and as free as possible from selection effects. The resulting identifications and x ray luminosities were used to check correlations with other cluster properties. Special consideration was given to observational selection effects and consistency checks. The data were consistent with all clusters of galaxies being x ray emitters beyond some limiting luminosity, which depends on cluster richness. Furthermore, the x ray luminosity of clusters is correlated with the richness of the cluster, its galaxy content, and the spacial distribution and galaxy content of galaxies within the cluster. It is concluded that the x ray emission from clusters of galaxies depends not only on the richness of the cluster but also the morphology of the cluster. Dissert. Abstr.

N91-12512 Harvard Univ., Cambridge, MA.
COMPONENTS OF COSMIC BACKGROUND RADIATION AND THEIR INTERACTION WITH MATTER Ph.D. Thesis
Boqi Wang 1989 151 p
Avail: Univ. Microfilms Order No. DA9013277

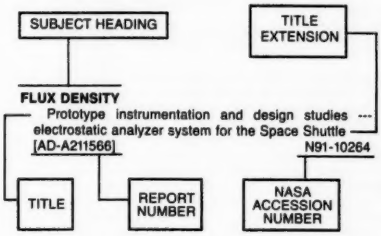
Two competing theories proposed to explain the newly observed background radiation at submillimeter wavelengths-emission of dust and radiative decay by weakly interacting particles are explored, emphasizing their possible implications on formation of structures in the early universe. It was discovered that the radiative instability resulting from interaction between dust and radiation cannot grow significantly to form galaxies and large-scale structures. Decaying particle models were shown to explain both the submillimeter background and the recently observed isotropic infrared background radiation at 1 to 5 microns. In addition, non-uniform distribution of decaying particles prior to their decay may act as sources of radiative blastwaves that could provide seeds for galaxy formation. It was shown that within the framework of decaying particle models proposed to account for both the submillimeter and infrared background, galaxy formation may occur as a result of the fragmentation of the bubbles swept up by radiation pressure originating from radiative decay. Dissert. Abstr.

99 GENERAL

N91-12513# Swedish Inst. of Space Physics, Kiruna.
[ACTIVITIES REPORT OF THE SWEDISH INSTITUTE OF SPACE PHYSICS] Annual Report, 1989
Lars Eliasson, ed. and Bengt Holback, ed. 1990 68 p
(ISSN-0284-169X; ETN-90-98234) Avail: NTIS HC/MF A04

Research on hot plasma including plasma spectrometer development and ground support equipment development for a plasma experiment on board Giotto is outlined. Data from the Swedish Viking satellite and Soviet Phobos spacecrafts is examined. Future plasma research is discussed. The laboratory of mechanical waves for their detection and signal processing and investigation of the middle atmosphere through measurement of the propagation of infro-acoustic waves is mentioned. Research on wave particle interactions, wave distribution functions, wave propagation is reported. Satellite and sounding rocket research is presented. The observatory and educational programs are outlined. ESA

Typical Subject Index Listing



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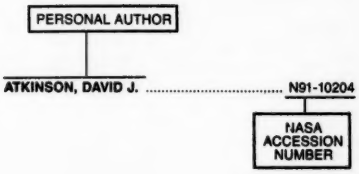

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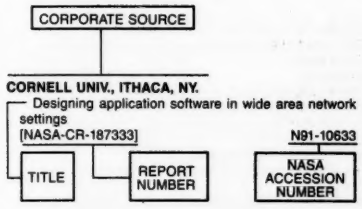

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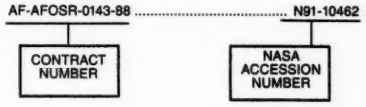

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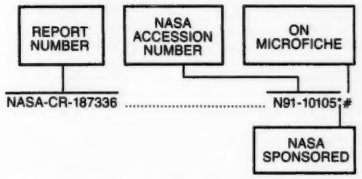

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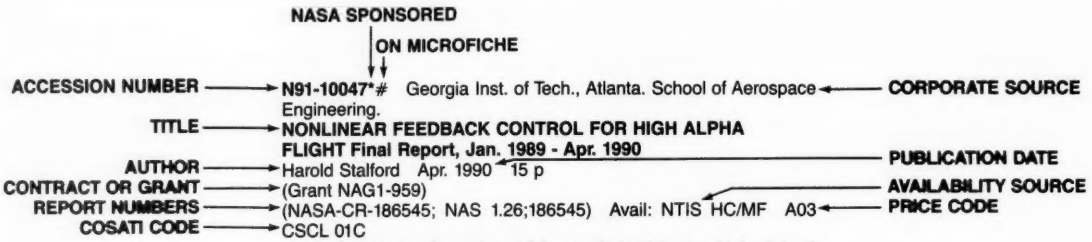

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